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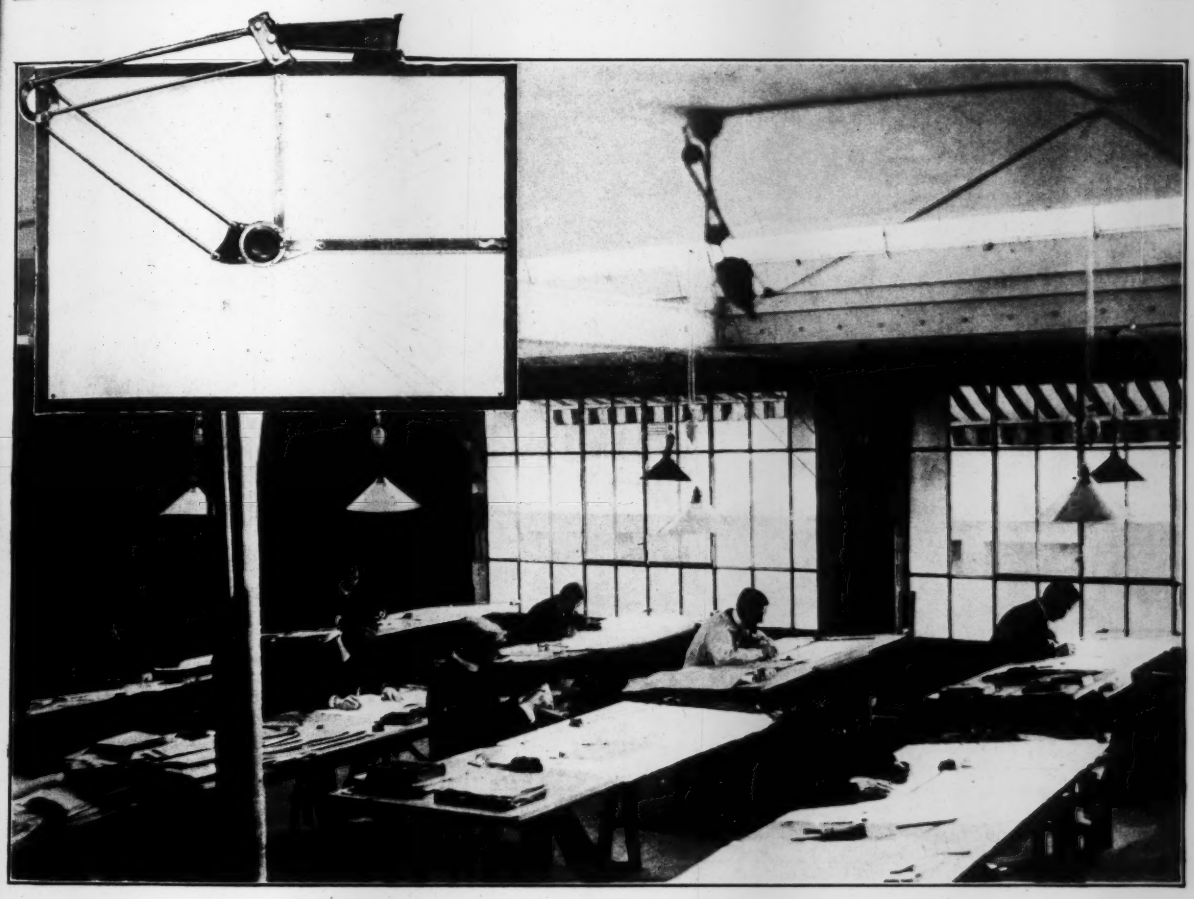

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Engineering News

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Box Concrete Retaining Wall on Western Pacific Ry.

By J. H. Knowles*

SYNOPSIS—Novel approach to a railway bridge. Thin reinforced-concrete retaining walls contain the earth-fill, the thrust being resisted by tie cross-walls of reinforced concrete.

The Western Pacific Ry. has recently constructed a very economical type of reinforced-concrete abutment and retaining wall in the replacement of a wooden trestle on its main line near Altamont, Calif.

The original structure was a 26-span frame-trestle approach to a steel-span overhead crossing of the Southern Pacific. The trestle bents averaged about 50 ft. in height and were built up on a pile-bent foundation. A county road 18 ft. in width passed under the trestle at its middle point, making a sharp right-angle turn at each side of the bridge (see Fig. 2). On account of a proposed change in location of this county road, which was never realized, the trestle had been partly filled in with material obtained from ditching cuts in the near vicinity.

In 1914 the California State Highway Commission located a part of the state highway approximately upon the line of the old county road. The width of the highway was increased to 24 ft.; and where it passed under the Western Pacific track, the grade was raised and the location shifted to a position adjacent to the concrete pier at the west end of the overhead steel span.

As the overhead clearance for the state highway was sufficient, a deck plate-girder bridge was decided upon to span it. The new location of the road, however, allowed but a limited lateral clearance between the right-of-way of the Southern Pacific and the proposed embankment of the Western Pacific. A retaining wall was therefore required back of the girder abutment. This location also necessitated the rehandling of a large part of the filling material that had previously been dumped from the trestle.

The soil at this point consists of a stratum of black loam saturated from numerous springs in the vicinity.

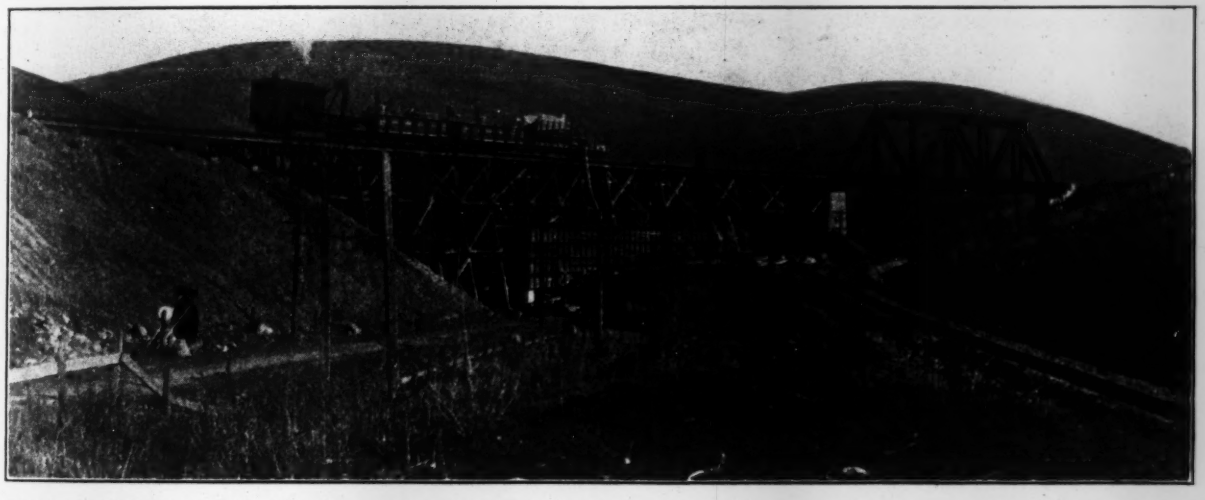


FIG. 1. RETAINING WALL AND ABUTMENT UNDER CONSTRUCTION ON WESTERN PACIFIC RY. AT ALTAMONT, CALIF.

This stratum is from 15 to 20 ft. deep and rests upon solid rock. The original soil was found to have been compressed and bulged out laterally by the superimposed fill, until it stood 61 ft. below subgrade. The rock foundation averaged 76 ft. below the track.

An ordinary type of reinforced-concrete abutment and retaining wall proved entirely out of the question; and as it was desired to fill in the trestle, a type of structure was designed that proved quite economical and allowed construction work to be carried on without interfering in any way with traffic. A slow order of 10 mi. per hr. had been maintained over the trestle for some time previous to the construction of the new work, on account of the difficulty of maintaining line and surface under the continuous settlement of the new filling material. This speed restriction for trains was further reduced to 4 mi. per hr. during the construction of permanent work.

*Bridge Engineer, Western Pacific Ry., San Francisco, Calif.

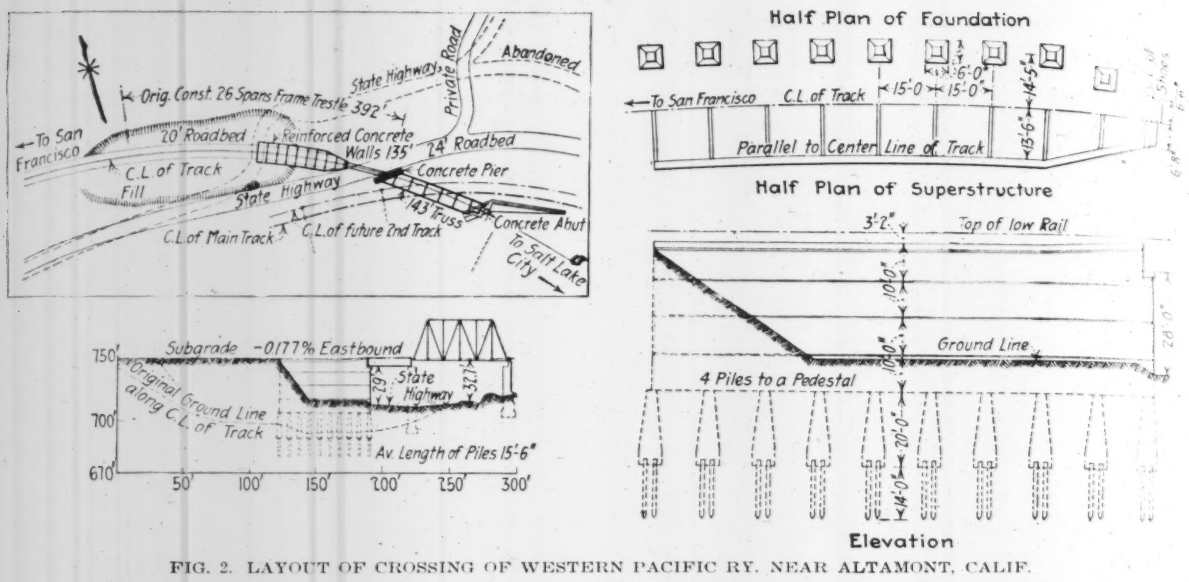


FIG. 2. LAYOUT OF CROSSING OF WESTERN PACIFIC RY. NEAR ALTAMONT, CALIF.

The structure, as shown in the accompanying photographs, consists of a thin abutment tied in by means of reinforcing bars to curtain walls 27 ft. apart, parallel with and equidistant from the center line of the track. The curtain walls are held in place by tie walls spaced 15 ft. centers, at right angles to the track. The foundation for the superstructure consists of plain concrete pedestals on wooden piles driven to bedrock. The pedestals are 6 ft. square at the bottom, 2 ft. 6 in. square at the top and 20 ft. high. They are placed under the curtain walls at the intersection with the tie walls. The pedestals and the walls were spaced 15 ft. apart longitudinally with the track, in order to fall midway between the timber trestle bents of the old bridge and leave them undisturbed during construction of permanent work and completion of filling after the concrete had set.

The curtain walls are 135 ft. long, 40 ft. high and have a maximum thickness of 22 in. at the bottom. Each 15-ft. span between tie walls is designed as a fixed beam with uniform loading consisting of the horizontal component of the weight of the inclosed fill plus the weight of the train and impact. Earth-filling was assumed at 100 lb. per cu.ft., and for live-load Cooper's E-50 loading was used with 80% additional for impact. Working stresses of 16,000 lb. per sq.in. for tension in steel and 600 lb. per sq.in. for compression in concrete were used. Reinforcement consisted of deformed bars rolled from billets of structural-steel grade. Concrete was 1:2½:5 mixture. The tie walls are 9 in. thick and simply serve to embed the steel reinforcement thoroughly, the fill on each side of the walls being assumed to exert equal pressure and cause no bending moments. This type of structure is therefore a hollow compartment box with neither top nor bottom. It has no overturning moments to contend with, nor direct vertical pressures other than the pressure under the foundation pedestals, which is probably very little more than the weight of the concrete structure itself, or about 3½ tons per sq.ft. No weep holes are placed in the curtain walls, as the bottom of the wall on the side opposite to the state highway stands about 10 ft. above the surrounding ground surface. The fill is prevented from flowing out from under the curtain wall by an earth berm 10 ft. wide out from, and 6 ft. above the

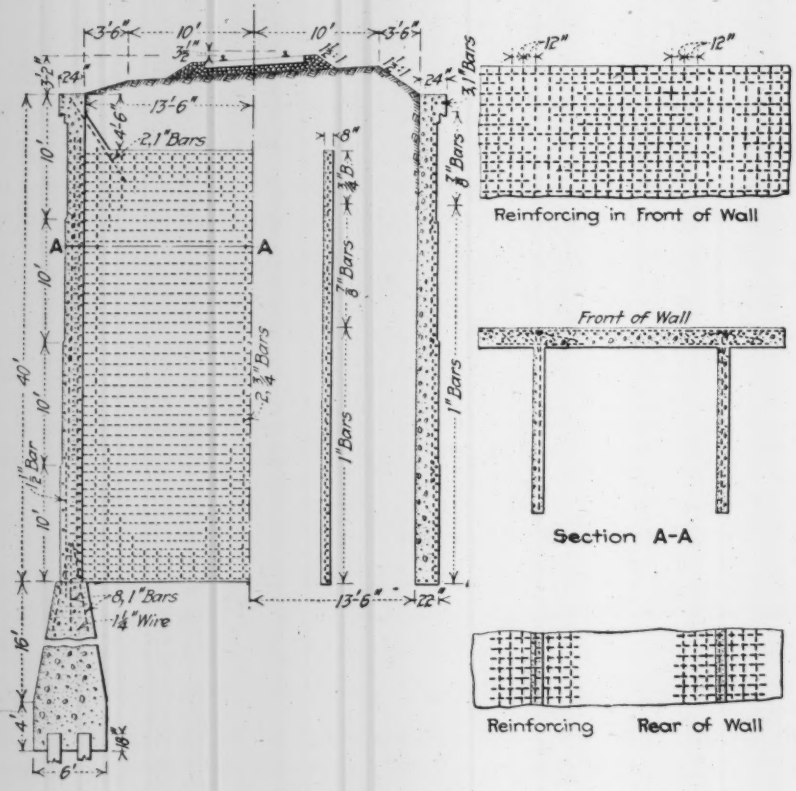


FIG. 3. DETAILS OF RETAINING WALLS CONTAINING FILL FOR BRIDGE APPROACH

bottom of, the wall. Excavation for the foundation pits was made by crab hoist and bucket, loaded by hand. Before starting excavation of pits the filled-in material was moved out from under the trestle by teams and scrapers to a plane 32 ft. below the base of the rail.

Construction Equipment

The equipment for concreting consisted of a ¾-yd. batch mixer and a 15-hp. horizontal gas engine mounted on a flat-car, followed by a car of rock and sand each—all moved by a self-propelling jumbo hoisting-car. The mixer-car also contained the cement. Water was obtained from a pipe line laid along the top of the trestle for this purpose. The concrete was chuted down into the forms through a 6-in. sheet-iron pipe. It was thoroughly spaded to prevent segregation.

The bridge was filled from the top with material from a steam-shovel cut about 2 mi. away. A work-train hand-

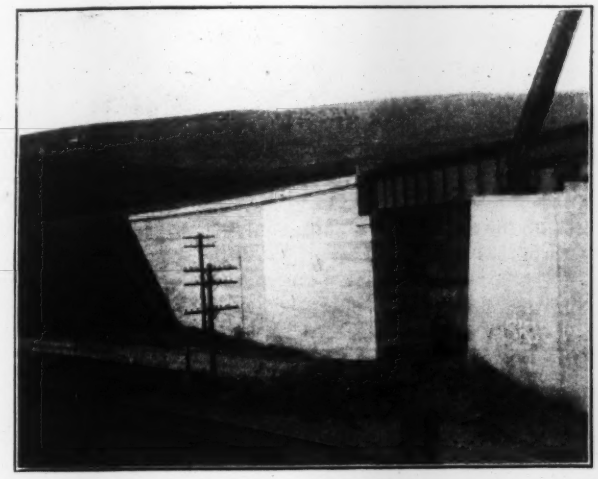


FIG. 4. NEAR VIEW OF THE ABUTMENT END WALL

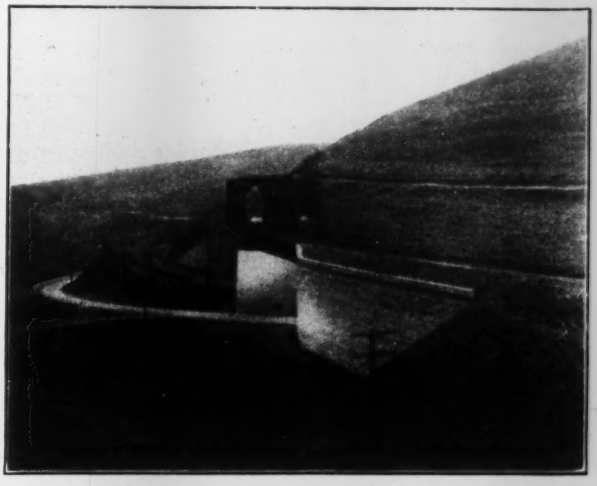


FIG. 5. GENERAL VIEW OF THE CROSSING

ling a string of steel hopper-bottom gondolas of 100,000 lb. capacity was employed.

The unit cost of concrete work ready for filling, including all delays in clearing for trains, of which there were eight per day during working hours, is as follows:

COST OF CONCRETE PER CUBIC YARD

Material	
Supplies for equipment	$0.29
Piles	.24
Cement	1.58
Sand	.08
Rock	.60
Reinforcing steel	2.73
Form lumber, nails and tie wire	.49
Freight on cement and reinforcing bars	.25
Labor	
Plant and equipment	1.20
Excavation	1.65
Piledriving	.26
Forms	2.18
Placing reinforcing	.63
Mixing and placing concrete, including delay by trains	1.55
Inspection of steel reinforcement	.02
Testing cement	.04
Store and miscellaneous expense	.33
Total cost per cu.yd.	$14.12

The total cost of steel girder, concrete retaining walls and fill was $62 per lin.ft. of track.

The work was done under the general direction of T. J. Wyche, Chief Engineer of the Western Pacific Ry. Original plans were made by Norton Ware, former Bridge Engineer. Modified plans to suit existing conditions were made by the writer, under whose direct charge the redesigned construction was carried to completion.

Progress of Lincoln Highway

The Lincoln Highway Association, which is promoting the improvement of a transcontinental highway from New York to San Francisco, reports that up to the end of 1915 about $2,250,000 had been expended on the improvement of the roads and the bridges along the route. All the way across New Jersey the highway has been surfaced with either concrete or macadam. On the route of the Lincoln Highway in Pennsylvania about $500,000 has been expended during the past 18 months. The effort in this state has been concentrated toward the abolition of toll roads and railway grade crossings. This is the one state on the route of the highway where tolls are still charged on some parts of the road.

In the State of Ohio 4 mi. out of 5 are now hard surfaced, and 66 mi. are paved with brick. About $350,000 has been spent on the road in Ohio during the past year, and bonds amounting to $600,000 have been voted by the different counties along the route. In Indiana 68 mi. of concrete roads are either under construction or bonds have been voted for them.

Among the contributions collected by the Lincoln Highway Association are 33,000 bbl. of cement, given by different cement manufacturers for use in building sample miles of road along the line of the highway. Several such "seedling" miles have been constructed in Illinois, and more are to be built this year. In Iowa the work on the highway has been confined to improvement of the earth roads, which have been graded, crowned, drained and dragged entirely across the state, at an expense of about $250,000.

In Nebraska, also, seedling miles of concrete have been constructed, but the main work has been in rebuilding bridges and dragging the earth roads. In Wyoming some $200,000 has been spent on the maintenance of the earth roads. In Utah and Nevada, with their enormous area and sparse population, expenditures on road work are necessarily small. About $75,000 has been spent on improvement of the highway in these states during the past year.

In California the Lincoln Highway from the state line to San Francisco is in fine condition, a considerable part of it being paved with concrete.

More Trouble at Austin Dam

The chapters of error and accident that have surrounded the masonry dam across the Colorado River at Austin, Tex., are by no means all written. Following the opening of the reconstructed dam last summer, as described in *Engineering News*, June 3, 1915, p. 1089, overtopping floods washed out practically all the crest gates, ruptured several of the sluiceway passages and filled the tailrace with débris. The owning company is in financial difficulties, and the contractor is not yet paid for his work. Taken all in all, the hoodoo that seems to haunt the dams of Austin is still in good form.

As was mentioned in the previous article in this paper, the crest gates were placed between piers that projected upward beyond the crest of the dam. A height of 15 ft. on the new reinforced-concrete section and of 6 ft. on the old masonry section brought the possible level of the pool to an elevation about 66 ft. above low water, which is 6 ft. higher than the original Austin dam crest and 5 ft. lower than the flood elevation of 1900, which washed out that earlier structure. The gates, both the 6-ft. and the 15-ft., were designed to be automatic in action.

They turned upon rockers in the form of segmental blocks set into the side of the concrete piers. The small gates were supported only at the main piers, which were spaced 20 ft. on centers; but the large gates had an intermediate pier or pedestal that gave central as well as end support. In order to prevent the gates from being pushed downstream when they turned, guide pins fixed in each end of the gate operated in curved channels of cast iron set into the concrete faces of the piers. This general construction may be seen in the photographic details given in Figs. 2 and 3. There were 28 large gates and 26 small ones, making a total of 1,091 ft. of spillway. The small gates were supposed to open automatically when the depth of water was 65 ft. 4 in. and close when it sunk to 63 ft. 10 in. The large gates opened at an elevation of 65 ft. 9 in. and closed at 64 ft. 8 in.

The design of the gates was most flimsy. The large gates, which were 15 ft. high by 18½ in. wide, were frames of 12-in. and 8-in. channels made in two sections. The two halves of the gate were held together by little else than the ⅜-in. plates of steel between the two middle channels, and the closure was made with some light wooden planks (Fig. 2). Furthermore, they did not fit tightly into the concrete opening between the piers, so that the 2,037 lin.ft. of openings between the sides and bottom of the gate and the adjacent piers afforded great opportunity for leakage. The view on page 1089 of the issue of June 30, 1915, showed some of this leakage going through the gates at that time.

Furthermore, the gate structure was not designed to resist the very heavy drift that always comes down the Colorado River. As a consequence the floods of 1915 carried away all but eight of the large gates and all but six of the small ones. The view in Fig. 1, taken in the fall of 1915, shows most of the large gates missing, and in the foreground may be seen some of the framework that has been washed downstream. It appears that some

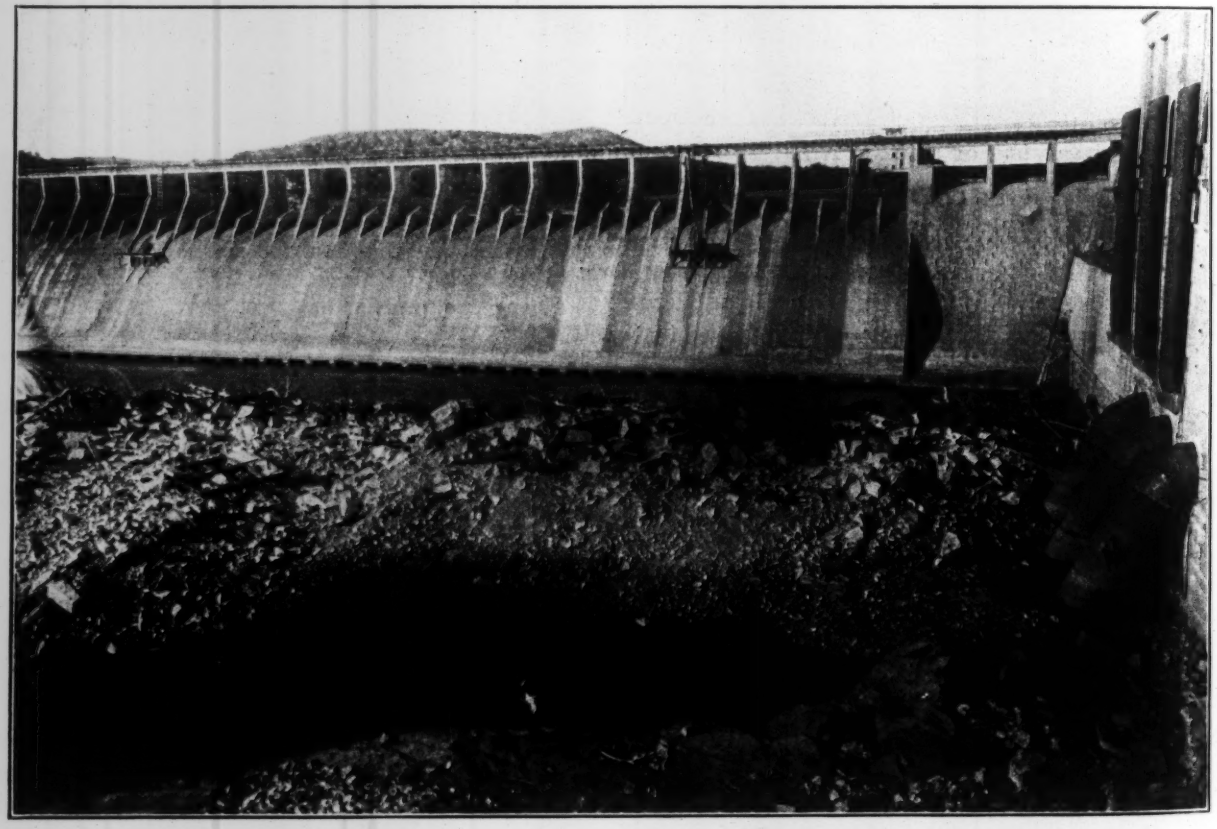
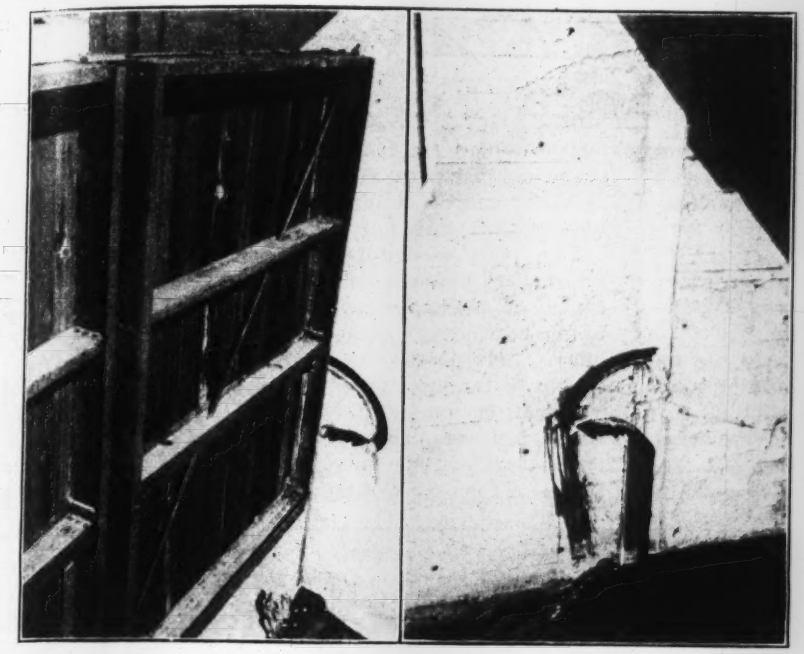


FIG. 1. LOWER FACE OF POWER HOUSE END OF AUSTIN, TEX., DAM AFTER 1915 FLOOD
Note the number of crest gates washed out and the gate frames on débris below dam. Also note choking of tailrace by débris



FIGS. 2 AND 3. NEAR VIEWS OF CREST GATES AND PIERS AFTER COLLAPSE OF GATES

Fig. 2—Shows rear of one of the gates. Fig. 3—Shows side of piers with bascule rocker and pin guide

of the gates failed from water pressure by simply doubling in the middle. A number of others failed by the lifting of the 3-in. plank that formed the face, leaving the gate frames in place. Others did not open as designed, and still others merely collapsed under the heavy pressure of the overtopping flood.

After the experience of leakage with the first high water of 1915 an attempt was made to fill up the joints around the gates and to make them water-tight. The original edging of the gates consisted of a steel angle, but later a 3x6-in. timber was bolted to the short leg of this angle; and to make a tighter joint, a 2x4-in. timber was bolted onto the water side of the 3x6. The 2x4 had a beveled edge sloped to the concrete side of the opening. The attempt was not successful, because the timber strips swelled in the water and prevented the automatic operation of the gates.

Another error in design was made in the location of the channels in the vertical faces of the piers in which stop logs were to be dropped in case the automatic gates did not act. The channels for these logs were located so that, when the automatic gates opened, the bottom of the gates was some 4 to 6 in. beyond the stop-log channel, thus making it impossible to use the stop logs in the emergency of the gates remaining open after the height of water had been reduced to the closing point, practically the only time when the stop log would be likely to be required.

Another weakness in the dam, developed by the recent floods, is the design of the sluiceways. As shown on page 1091 of the issue of June 3, 1915, the tunnels through the center and lower part of the hollow dam were provided with an arched roof with the reinforcement in the lower plane. When the sluiceway gates were opened, there was enough pressure in the tunnel to blow up this roof in some of the sluiceways, as it was not reinforced for pressure from below. An effort was made to repair this error by laying rods on the top of the slab and filling in 4 to 5 in. of concrete. This work was stopped last fall when the owning company got into difficulties.

The view in Fig. 4 also shows another deplorable condition in the encroaching piles of débris in the tailrace from the power house. The débris from the old dam had filled in this general area, but a canal had been excavated through it up to the power house. After the recent flood, drift which came over the dam and material from the old pile of débris below the dam washed into this canal and so effectively closed it that the power house has to shut down after every flood, and thousands of dollars will be necessary to excavate a channel of proper dimensions.

The City Water Power Co. of Hartford, which temporarily owns the dam, is now in a receiver's hands, and the contractor has a mechanic's lien for $300,000 due him. The dam and the power plant do not become the property of the city until completed to the satisfaction of the city and until they have been operated for 25 years. The terms of the contract appeared in the earlier articles in this journal.

Lectures on Structural Timber

A course of 14 lectures on structural timbers has recently been arranged in the college of engineering of the University of Wisconsin to be given by members of the staff of the United States Forest Products Laboratory.

While engineering courses have heretofore covered the design and working stresses for two or three standard woods, there has been a great dearth of information concerning the properties of many of the well-known species and, in particular, a great lack of knowledge of how to identify the material actually supplied. As the result of several years of study and experiment the Forest Products Laboratory is able to formulate much more exact information along these lines than was formerly available and has now assembled this information for a brief course of lectures carefully adapted to the needs of engineering students. The various topics covered in this new course are, briefly, as follows:

Structure of Wood—Arrangement of cells, fibers, annual rings, heart and sap wood; key to the important species.

Mechanical Properties—Factors influencing mechanical properties; density defects; values of constants for different species; laboratory demonstrations.

Durability—Factors influencing durability, species, density; fungi; conditions of growth; standardization of lumber yards; preservative treatments.

Grading Rules—Purpose of rules; quality of the various grades.

Species Used for Structural Purposes—Species by regions and price of various grades and species; laboratory demonstrations.

Design of Timber Structures—Proper working stresses; efficient design with respect to strength; danger from fire and decay. Efficiency of wooden joints; holding power of nails, etc.; standardization of construction.

Building Codes—Lack of specifications for timber; specifications of National Board of Fire Underwriters.

Bank Protection Above Sibley Bridge; Santa Fe Ry.

SYNOPSIS—History of dike and mattress protection of banks of Missouri River near Sibley, Mo. Abstract of Santa Fe Ry. specifications for the construction of bank revetment. Cost figures.

Before the Sibley bridge of the Atchison, Topeka & Santa Fe Ry. over the Missouri River below Kansas City was completed in 1887, the railway company was compelled to enter upon a program of river-bank protection, which has continued ever since and has involved an expenditure almost, if not quite, equal to the original cost of the bridge. This work is of a character and extent equal only to some of that done on the Missouri and Mississippi Rivers by the United States Engineer Department. A record of this work forms an interesting and very essential chapter in the history of the Sibley bridge.

The exposed position of the bridge and bridge approach from the east can be readily appreciated by a study of the map, Fig. 2. While the erection work was still in progress in February, 1887, the river began encroaching to such an extent that a material track along the east bank had to be taken up and moved back some distance. The first bank-protection scheme was designed at this time by the late Octave Chanute. This plan provided for a series of dikes (or preferably jetties), shown on the plan as 1, 2, 3, 4, 5, 6 and 7 and *A*, *B* and *C*. Other protection works are also shown on the map.

These dikes were built in the winter of 1887-88. The first ones, *A* and *B* and 1 to 7, were built on the three-mattress system, which consisted of a woven willow mattress on the bottom, a layer of stone or riprap, another mattress and layer of riprap and a third mattress heaped high above the low-water line with riprap. The bottom mattresses were 100 ft. long, 45 ft. wide and 2 ft. thick; the second mattresses were 80 ft. long, 40 ft. wide and 2 ft. thick; and the third mattress was 60 ft. long, 35 ft. wide and 2 ft. thick.

The dike *C* was built at the same time. It was constructed on a foundation mattress, built on the Eads system of two-timber grillages, each composed of 2x6-in. timbers crossed about 4 ft. one way and 5 ft. the other. Between the timber grillages was woven willow work, and then the timber frames were pinned together. This mattress was 750 ft. long, 45 ft. wide and 2 ft. thick. Through it were driven a double row of piles—the rows 6 ft. apart and the piles in each row 8 ft. c. to c., staggered from those of the opposite row. Into each row were woven willows to form a double screen or wattle dike. The mattress for this and the other dikes was built on the ice and sunk when the ice melted.

FIG. 1. MATTRESS WORK ON MISSOURI RIVER ABOVE SIBLEY BRIDGE

BANK PROTECTION, SIBLEY BRIDGE APPROACH, ATCHISON, TOPEKA & SANTA FE RY.

Date	Protection	Lin.Ft. Protected	Cost
1887	Dike 1	....	$7,303.60
1887	Dike 2	....	7,274.02
1887	Dike 3	....	5,219.29
1887	Dike 4	....	7,277.21
1887	Dike 5	....	6,775.21
1887	Dike 6	....	6,120.70
1887	Dike 7	....	8,969.28
1888	Dike C	....	29,009.07
1888	Dike B	....	3,170.62
1888	Dike A	....	4,094.01
1891	Eads' mattress	4,360	47,711.63
1894	Woven mattress	2,664	26,228.45
1898	Woven mattress	6,484	39,552.17
1900	Woven mattress	2,044	17,163.22
1904	Woven mattress Wattle dike	390 1,200	27,343.79
1906	Woven mattress	2,530	27,612.91
1908	Woven mattress	520	5,463.43
1909	Woven mattress	390	3,188.43
1888 to 1896	Dikes and restoring river bank	.....	57,587.36
	Total	.....	$337,064.40

The figures cover material and labor costs only and are not the full cost of the work. Since 1910 some repair work has been done, the cost of which is not included in the compilation.

In 1891 this dike *C* settled down in the middle and was restored by more mattress work and riprap filling. Since then it has been kept in repair up to the low-water level. As can be seen from the plan, Fig. 2, it serves to protect a considerable stretch of bank; but at high water the lower end is overflowed, and at such times the river often gouges out a hole from a quarter to a half mile in diameter on the downstream side.

By 1894 the ineffectiveness of the dikes became evident. The river suddenly began to erode the bank above dike 7, and it was then that the first revetment mattress was built and placed. This was one continuous mattress 61 ft. wide and 2,664 ft. long. Up to this time about $60,000 had been spent restoring the dikes and patching up breaks in the river bank. Since then dike building has been abandoned and reliance placed in mattress protection, except, as mentioned, that dike *C* has been kept in serviceable condition.

Subsequent new mattress work was done in 1898, 1904 and 1910. In 1906, 1908 and 1909 about 8,000 lin.ft. of mattress was also put down, but this was in the nature of patching or extending existing mattresses above their original levels. A summary of the work, as shown by the accompanying table, makes the whole cost $340,000. This summation does not include much small repair work, some of it done as recently as last year, when 125 ft. of mattress was added between dikes 6 and 7. The table was recently compiled by G. J. Bell, now district engineer at Newton, Kan., who for more than 25 years was in charge of the work. Together with notes and other material, it was placed at the disposal of *Engineering News* through the courtesy of R. A. Rutledge, Chief Engineer, Eastern Lines, Santa Fe Ry., and Mr. Bell.

In 1910 a new system of bank protection was developed and used to some extent on the Missouri River at a point a few miles above the work described. It consisted of a river-bed protection of the usual mattress type, with a reinforced-concrete slab protection for the river bank above the low-water line. This work was examined by Mr. Bell late in 1915 and found to be in excellent condition.

He recently codified his 25 years of experience on the Missouri River for the benefit of other engineers of the Santa Fe, and these specifications are given herewith. They differ in some essentials from the Government specifications for similar work and have been found to answer the needs of the railway to better advantage.

SPECIFICATIONS FOR BANK PROTECTION

The general plan of bank protection shall consist of revetment work with willow mattresses. The mattresses shall consist of woven willow 12 in. thick and 100 ft. wide, sunk to the bed of the river along and parallel to the shore, the inside edge being about 10 ft. inside the low-water line and extending along anchor piles.

The outer edge shall be weighted with rock of 40 to 60 lb. weight, securely wired to the mattress to insure its sinking. Sufficient rock shall be placed on the upper end of the mattress to secure it in place while the rest of the mattress is being sunk; the quantity of rock is to be not less than 1.2 nor more than 1.8 cu.yd. for 100 sq.ft. of mattress.

The mattress shall be woven with a selvage edge and shall be strengthened longitudinally and transversely with a system of ⅝-in. galvanized-wire cable spaced 10 ft. apart in each direction. The cables shall be placed on the under side of the mattress, but at each intersection they shall be pulled through the mattress and securely toggled to it, and the longitudinal cables shall be doubled.

The mattress shall be woven around, and the transverse cables shall be attached to, the anchor piles, which are spaced 10 ft. apart, c. to c., and driven 15 to 20 ft. into the bottom.

The bank above the low-water contour shall be graded to a uniform slope of 3 ft. horizontal to 1 ft. vertical and faced with a reinforced-concrete blanket protection constructed as follows:

Placing a layer of cement and sand mortar 3 in. thick and woven-wire fencing 6 in. mesh placed on top and securely fastened together with smaller wire with a second layer of cement and sand mortar placed before the initial set of the first layer, with expansion joints as directed by the engineer.

WEAVING THE MATTRESS

The mattress shall be woven by skillful weavers, and only straight, live willow brush shall be used; brush about 2½ in. in diameter at the butt and about 15 ft. long will be preferred.

The mattress shall begin at a point on the upstream end and shall be widened as rapidly as possible until the full desired width is obtained. While being so woven, the longitudinal cables shall be securely fastened to piles or deadmen on the shore, 150 to 200 ft. above the point of the mattress.

Cables of ⅜-in. galvanized-iron wire of the best quality shall be used. The cables shall be laid under the mattress longitudinally and transversely at intervals of 10 ft. and shall be securely fastened at the selvage end of the mattress and

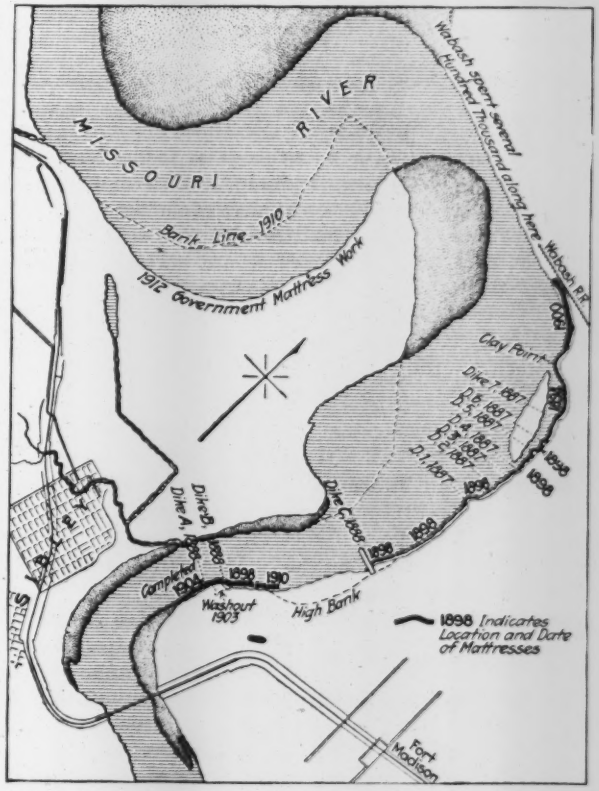


FIG. 2. MAP SHOWING BANK PROTECTION WORK NEAR SIBLEY, MISSOURI

at each intersection of the cables. The cables shall be pulled through the mattress and fastened with a hardwood pole 4 in. in diameter at the small end and not less than 12 ft. long. The cables shall also be securely attached to the anchorage piles by taking two turns around the pile and tying the end with two half-hitches.

SPECIFICATIONS FOR THE PILES

The piles shall be round native timber. They shall be straight and not less than 10 in. in diameter at the small end, and shall be 24 ft. long. They shall be driven from 15 to 20 ft. into the bank, as directed by the engineer. When necessary, iron bands shall be used in driving to prevent splitting.

Rock for sinking the mattress shall be uniformly distributed to an average depth of from 4 to 6 in., as required by the engineer. The stone shall be brought in on barges and floated over the mattress from the upstream end at right angles to the mattress, and the stone shall be thrown from the upper and lower sides of the barge upon the mattress.

The sloping of the bank shall be done as directed by the engineer: it is desired to secure as nearly as possible a uniform slope of 3 ft. horizontal to 1 ft. vertical.

Snags, logs or other obstructions in the bed of the river, that would prevent the mattress from resting uniformly on the bottom, or which would interfere with the anchorage on shore, shall be removed, and all spalls shall be hauled and placed on the paved bank, if directed by the engineer.

Comparing the cost of the reinforced-concrete bank protection with willow-mattress work under similar conditions gives some interesting results. In 1906 some 924 squares (of 100 sq.ft. each) of river mattress were laid at a total cost of $2,612.32, or $2.82¾ per square, divided as follows:

	Total	Unit
Cost of driving piles	$61.48	$1.28
Cost of weaving and handling brush	454.60	.60
Cost of sinking	445.71	.482

Cable used, 21,620 lin.ft., or 23.41 lin.ft. per square.

The cost of a bank mattress at the same time and place was as follows:

Labor of weaving and handling brush	$55.59
Brush, labor and cutting	77.56
Royalty, 61.4 cords at 10c.	6.14
For 119.1 squares (100 sq.ft.)	$139.29
Per square	1.17

All of these figures, as before, cover only labor and material.

The cost of reinforced-concrete bank protection constructed according to the methods given in the foregoing specifications at this same point on the river in 1910 was 11c. per sq.ft., or $1.10 per square, while the estimated cost of another willow mattress for the same purpose was 10c. per sq.ft., or $1 per square. There has been trouble with concrete-slab revetment work on the Santa Fe in California, through water getting under the slab and carrying it away, so that it is very necessary to have such work carefully protected from erosion at the edges.

Pittsburgh's Smoke 75% Cured

Effective work in abating the Pittsburgh smoke nuisance, since the 1914 prevention ordinance, is shown in the recent 1915 report of the Bureau of Smoke Regulation. The estimate of the chief of the bureau is that the amount of smoke emitted has been reduced 75%.

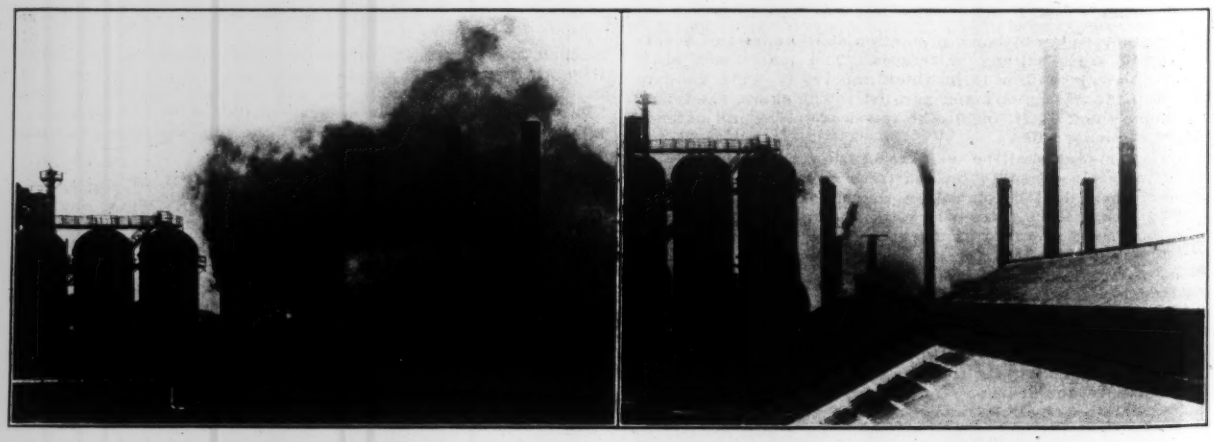
The regulating ordinance generally prohibits the emission of smoke of density equal to or greater than No. 3 on the Ringelmann chart for more than 2 min. out of any 15. Locomotives and steamboats are limited to 1 min. in any 8, except for 20 min. twice a day.

In past years dark days, when it was necessary to have street lights going all day, were a more or less common occurrence. The records of the local office of the United States Weather Bureau show that in 1913 there were 57 days during which there were periods of at least one hour of "dense smoke." During 1914, efforts for smoke abatement under the present ordinance were started, and the number of "dense smoke" periods was reduced to 32. In 1915, although fully two and a half times as much coal was burned as in 1914, there were but 26 days containing these periods.

No "cure all" has been developed for the smoke nuisance, although numerous devices have been patented. Appliances that give smokeless operation in other districts fail to operate smokelessly when using the Pittsburgh coals. Complete and free combustion eliminates smoke, and some mechanical stokers have been installed that successfully accomplish this end. The listed alterations in Pittsburgh toward smoke abatement in the year include changes to gas, coke and low-volatile coals, installation of down-draft boilers, inclined chain-grate stokers, underfeed stokers, steam jets and extension of stacks. The reported savings in fuel with improved combustion range from "interest on the investment" up to 18 and 20%.

The railroads have coöperated. The Pennsylvania R.R. has 850 engines, out of a total of 1,040 in active service on the western Pennsylvania division of the lines east of Pittsburgh, equipped with brick arches and superheaters. Engines working in shifting service in Pittsburgh use low-volatile coal, and the engine-house terminals are supplied with low-volatile coal for firing up and banking fires in passenger locomotives, which use gas coal in regular service. Twelve railroad inspectors make reports on locomotive smoke conditions, and in 1915 they observed 179,822 locomotives, criticized 826 and instructed 19,302. The railroad finds, as do other power-plant owners, that economies in operation very frequently accompany good results in reducing smoke. At the Allegheny engine house of the Pennsylvania lines west of Pittsburgh a smoke-collector system is in use and an electric smoke precipitator is placed in the single stack, at an expense of $51,000.

Pittsburgh's Smoke Bureau costs the city $11,000 per annum, against which it is hard to compute the annual saving, although the University of Pittsburgh in its research on the smoke problem estimated the annual loss by smoke at $10,000,000. If the damage is proportional to the smoke, the gross saving would be $7,500,000.



BEFORE AND AFTER THE PITTSBURGH SMOKE-ABATEMENT CAMPAIGN

Steep Grade on San Francisco Street Railway Overcome

One of the contemplated extensions of the San Francisco Municipal Railway System, made possible by the $3,500,000 bond issue approved by the voters in August, is to give additional transportation facilities for the densely populated Noe Valley district by a line from Market St. and Van Ness Ave. to Church St. and thence to 30th St. But the grades here are prohibitive for electric railways, and means of overcoming them were made the subject of special study by the City Engineer, M. M. O'Shaughnessy. A plan was devised and approved by the Board of Supervisors, and contract has very recently been awarded for construction.

Southward from its intersection with 18th St., Church St. ascends a 14.4% grade for a distance of one block—520 ft. in length. In the next block south are ascending grades, 7.9% for half the distance and 1.75% for the remainder. From 20th to 21st St. is a 19.3% ascent. Thence the descent is at the rate of 11.5% for a distance of 520 ft., to 22nd St.

Five possible methods of solving the problem were submitted to the Board of Supervisors, together with a cost estimate of each.

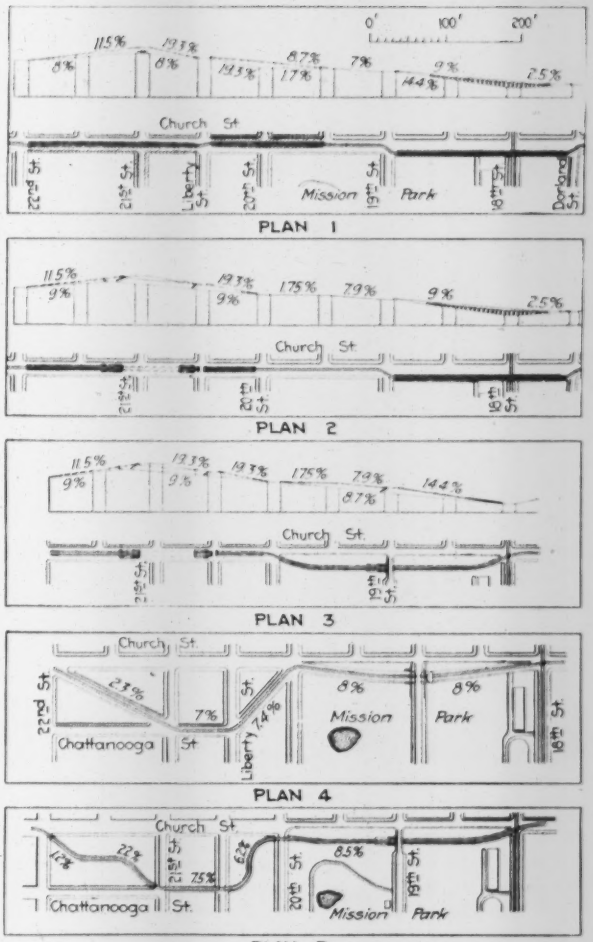
The first plan (shown as Plan 1) contemplated the construction of a reinforced-concrete viaduct from Dorland St. to 19th St., the raising of the grade on one-half the width of Church St. from Cumberland to Liberty St. and the lowering of the grade on one-half the width of Church St. from Liberty St. to 22nd St. This would involve reinforced-concrete walls to retain the cut and fill, as well as an additional cut on 21st St. The entire cost of this project was estimated at $210,000.

The second plan outlined (Plan 2) was a modification of the first, a tunnel with open-cut approaches being substituted for the open cut at the crest of the hill. The cost was estimated at $230,000. Its advantage would be that the existing street grades at 21st and Church St., to conform with which numerous homes near that corner were constructed, would not be destroyed. In both these plans the maximum grade for the proposed railway would be 9%. In Plan 1, however, the grade at the crest of the hill would be 1% less than with the tunnel.

Plan 3 contemplated a tunnel with open-cut approaches at the crest of the hill, as in Plan 2, but instead of a viaduct a detour was made toward the east, involving an open cut with side retaining walls through the westerly side of Mission Park, 19th St. would be carried across the cut by a bridge. The cost of this project would be the same as for Plan 2—$230,000.

Plan 4 contemplated two separate detours—one between 18th and 20th St., through Mission Park, as in plan 3; another around the crest of the grade, as shown. Under this plan it was intended to provide a boulevard 70 ft. in width for the entire distance from 18th to 22nd St. The center of the boulevard was to be occupied by the Municipal Railway tracks and the remainder retained for vehicular and pedestrian use. The necessary property between 20th and 22nd St. would be acquired by condemnation proceedings. The cost of this project was estimated at $330,000, of which $170,000 would be for real estate.

Several property owners objected to Plan 4 on the basis that the cost would be excessive and that, although the boulevard was a very desirable feature, it could be dispensed with. Many were unwilling to pay any assessment even for a railroad. This project was therefore modified by narrowing the proposed right-of-way to 28 ft., omitting the boulevard feature and slightly readjusting the route. In this form (Plan 5) the project was finally approved by the Board of Supervisors. The cost is estimated at $210,000.



PLANS PROPOSED FOR OVERCOMING GRADES, CHURCH ST. MUNICIPAL RY., SAN FRANCISCO

Besides the solutions of the problem submitted by the City Engineer several were proposed by outside parties. One of these was a cable line from the top to the bottom of the grade, by which a car ascending would be counterbalanced by one going in the opposite direction. The objection to a cable road was that the running time over the line would be materially increased, owing to delays in coupling and uncoupling. It was also pointed out by the City Engineer that the operation of the cable would be dangerous, as the municipal cars are all heavy, weighing approximately 25 tons and capable of carrying a passenger load of 9 tons. Several accidents have occurred on a line at present operated down Fillmore St. hill, San Francisco, in this manner. Another proposal was to lower the crest of the hill 28 ft., thus lessening the approaching grades to a maximum of 11.6%. This plan was considered undesirable by the City Engineer, so both were abandoned for the ones outlined in this article.

Modernizing the Manchester Water-Works

SYNOPSIS—Bringing up to date a water-works started in 1874. Old system pumped by hydraulic and steam power; new equipment for generating electricity by water and steam and driving all pumps by electric motors. Operating practices are outlined.

The interesting old municipal water-works supply system at Manchester, N. H., is now being replaced by modern equipment. The historic works are of interest to older water-works men, as they were designed by the late J. T. Fanning and built under his immediate supervision in 1874-75.

The source is Lake Massabesic, which has an area of about 4 sq.mi. and is some 4 mi. east of the city. As the works were first laid out, the outlet of the lake was dammed by a stone and earth structure and the water diverted through 1,500 ft. of canal to 625 ft. of Georgia pine penstock supplying a pair of Risdon vertical-shaft Jonval type wheels driving, through wood-tooth gears, a vertical quadruplex single-acting Wood pump. A 24-in. wrought-iron cement-lined force main, 7,200 ft. long, led to a 15,000,000-gal. distributing reservoir.

In 1886 a horizontal duplex double-acting Davidson pump was put in, driven by the countershafts of the first quadruplex unit. For some unaccounted reason this pump, instead of taking its suction from the penstock, drew from a well fed by the tailrace, increasing the necessary lift by some 40 ft.

In 1893 a 4,000,000-gal. high-level reservoir was built 138 ft. above the low-level reservoir and 2 mi. north. To supply it, a steam station was erected on the shores of the lake about due east of the reservoir. The high-level force main was brought out to meet the low-service distribution main before going to the upper reservoir. A valved connection allowed pumping into the lower reservoir by the steam station in times when it was desired to conserve the supply by stopping the turbines of the low-service plant.

In this steam station there were placed two 3,000,000-gal. 115-lb. Worthington horizontal compound condensing duplex double-acting units with high-duty attachment. The friction of the pipe was too great, however, under the flow of both pumps for satisfactory operation; and to increase the capacity, in 1901 a Snow 6,000,000-gal. 125-lb. vertical triple-expansion condensing crank-and-flywheel single-acting pump was installed.

With the plant in this stage of development the low-level turbine-driven pumps supplied the low-service reservoir in times of ample water, and the triple-expansion unit provided for the high-level service. In times of low water the Snow steam pump was run in the daytime to supply the high-level and the two Worthingtons in the night to fill the low-service reservoir.

As Manchester is one of the important mill cities of New England and has now a population of about 77,000, adequate and uptodate water service for both fire protection and municipal supply is essential. In 1909 the fire protection afforded by the water-works was severely criticized by the engineers of the National Board of Fire Underwriters.

In 1911 the two 150-hp. boilers at the steam station, which had both to be run continually, were replaced with two 250-hp. units, only one being used at a time. In this year also a 6,000,000 De Laval motor-driven centrifugal pump was placed in the low-service plant, electric power (2,300-volt alternating current) being purchased from the Manchester Traction, Light and Power Co. This addition provided an emergency and standby service, not largely employed on account of the cost of the power.

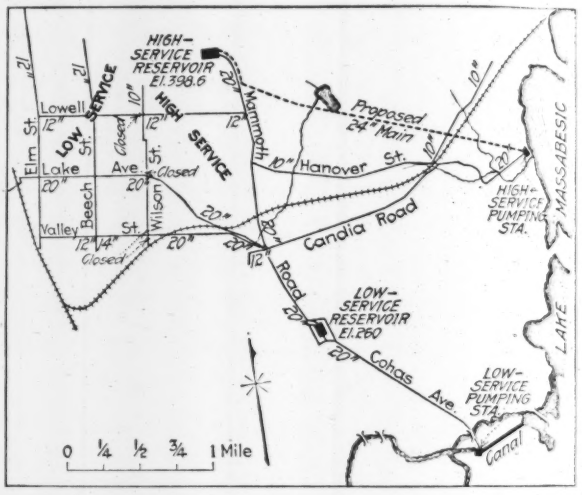


FIG. 1. SKETCH MAP OF MANCHESTER WATER-WORKS

In 1915 the old duplex and quadruplex turbine-driven pumps were removed and replaced by a modern electric generating unit consisting of two Trump wheels on a horizontal shaft drawing water from a central casing and driving a 500-kw. 2,300-volt generator. A transmission line has been built connecting the hydraulic and steam stations, and a 3,000,000-gal. motor-driven centrifugal unit has been placed in the latter plant. The generator is run by one wheel to drive the 6,000,000-gal. low-service motor and pump or the 3,000,000-gal. high-service machine. With both turbines in service the generator carries the two centrifugal pumps.

The next step will be to replace one of the old Worthington compound steam pumps with a steam-turbine generating unit that can drive either the high- or the low-level pump, or both in time of drought or low water.

A Historic Penstock

The old wood penstock removed was one of the first large wood-stave pipes built in the country and presents one of the longest experience records. Wood was used for economy; this pipe cost about $9,150, compared with estimates of $21,600 for cast iron and $22,800 for wrought iron. The pipe was 600 ft. long and 6 ft. clear inside diameter. The head on it varied from 12 ft. at the upper end to 38 ft. at the foot; the velocity of flow was designed to be 4 ft. per sec. It was built in place in a trench averaging 13 ft. deep. The staves were cut

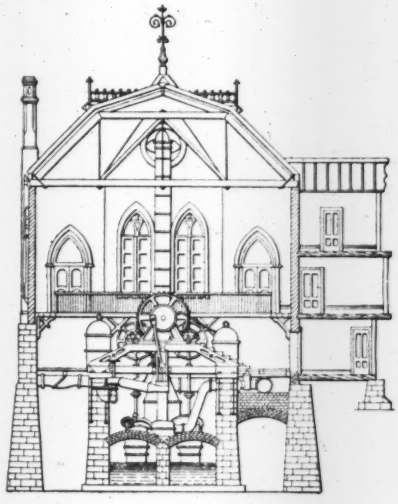
from pitch-pine plank, 4 in. thick, with the side joints dressed to radial lines. (The construction was described at length by Mr. Fanning in the "Transactions" of the American Society of Civil Engineers, March, 1877.)

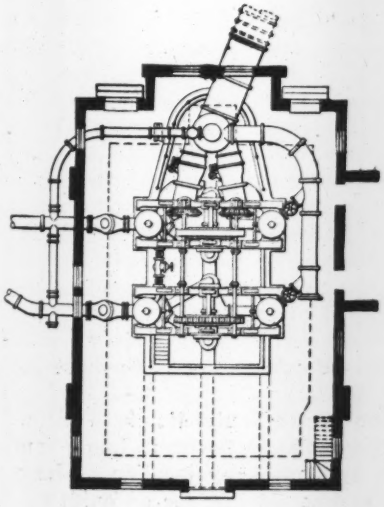
The hoops were of iron ½x2½ in. and ⅜x2½ in. The staves were of unequal length, averaging 13 ft. Joints in adjoining staves were not allowed to come together. The butt joints were sealed by an iron plate ⅛x1x4 in. let into a ½-in. saw cut. Plates and hoops were given a heavy coat of red-lead paint. As may be seen in the accompanying sketch—made from the old plans—two changes in slope were made to lessen the excavation. At the points of change a continuous joint was made entirely around the pipe; this was covered with a broad wrought-iron hoop and calked with oakum soaked in red lead and oil. It was planned to cover the penstock with a thin layer of concrete; but as the ground was naturally moist and apt to remain saturated, this was not done. The penstock terminated in a 12-ft. section of cast-iron pipes, from which a 30-in. standpipe rose about 40 ft. high and two 44-in. turbine branches and a 30-in. pump-suction line were led off.

The old pipe was taken out at the time of rebuilding the dam (1913) and a steel pipe substituted. The general condition of the staves was good, but there were numberless leaks through sappy ends. These spots were so rotted that general repairs were out of the question.

The old stone overfall section of the dam had been built with timber construction for the screens at the canal inlet. All this timberwork had rotted out, and the dam had several bad leaks. The repairs would have amounted to so much that it was decided best to replace the old structure with a modern one. The water had to be shut off about 60 days for this change.

The wrought-iron cement-lined force main laid in 1874 has been replaced with a 24-in. tar coated cast-iron line. The original distribution lines were of cement-lined pipe, but they have been largely replaced by cast iron. The lines were so well placed, however, that practically no revision has been needed up to date.





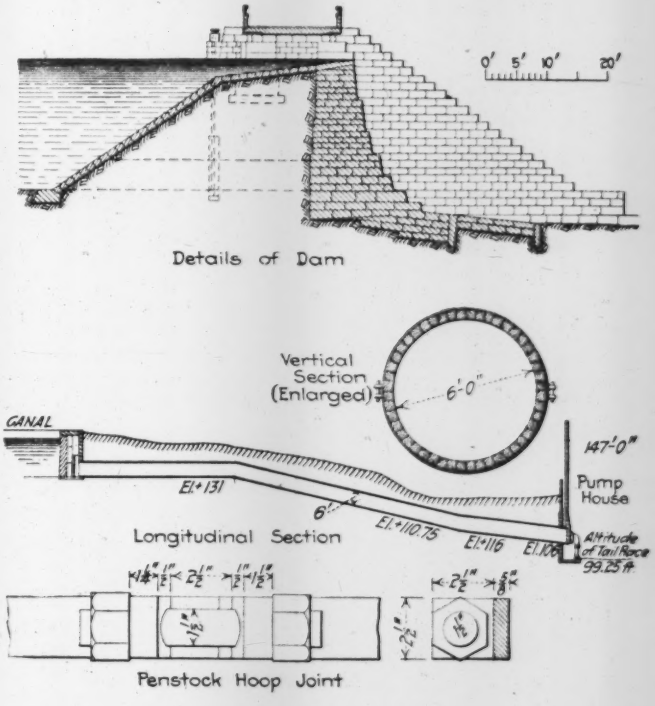


FIG. 2. OLD DAM, PENSTOCK AND POWER PUMPS AT MANCHESTER, N. H.

Original equipment of works designed by J. T. Fanning; replaced 1913-15 by modern designs

Up to 1912 attention to administrative details was loose. Drawings and documents were scattered from cellar to garret of the building occupied. They have now been collected, indexed and stored in a fireproof vault. The entire system has been mapped, and detailed locations of gates and service pipes are now gathered on index cards. Records are kept of station operation and hydrant-pressure tests.

The cost of hauling coal to the high-service steam plant has been cut from $1 to 50c. per ton by use of a motor truck. The truck is employed at other times in repair and construction work. It carries an emergency tool kit at all times, and the repair crew can be quickly assembled for special services.

Water is distributed about the city through two services: The low, supplied by gravity from the distributing reservoir, serves the central, west and south sections, most

of the mercantile and manufacturing districts and the closely built residential district; elevations run from 20 to 180. The high service serves the north and east sections (residential) and has an extension to the west side (across the Merrimac River); elevations average from 105 to 325. Numerous emergency connections are provided between the two services, as shown in Fig. 1.

The average daily consumption is 2,652,000 gal. from the low service and 1,492,000 from the high, giving a per capita figure of 54 gal. About 80% of the service connections are metered, there being some 6,400 meters and 7,900 connections. The metered rate is 10c. per 100 cu.ft. for the first 100,000 cu.ft. per quarter; all above is charged at 7c. An annual minimum of $8 is imposed. There is also a long list of various flat rates. The city is charged $25 per year for each hydrant. The meter rates are to be compared with a rate in 1875 of 40 to 10c. per 100 cu.ft. (for 15 and over 100 cu.ft. per day respectively). The first charge for hydrants was $60. It is interesting to notice that the "rules and regulations" now imposed on customers show comparatively minor changes from those worked out by Mr. Fanning in 1875.

The city has gradually increased its holdings of land around the shores of Lake Massabesic until it owns some 82%; it has control by agreement of over 10% more of the shore. In 1913 a start was made in reforesting the vacant land of the water department. In that year 40,000 fine seedlings were set out, and in 1914 and 1915 there were planted 100,000 more. The first seedlings show excellent growth, many being 30 in. high.

The total cost of works to Dec. 31, 1915, was $2,371,000. The present bonded indebtedness is $350,000; $550,000 has been paid out of the sinking fund already—in retiring bonds—and there is $96,073 cash in the fund.

Most of the improvements noted have been made under the general direction of Capt. Charles H. Manning, the well-known veteran engineer, President of the Water Board, with the immediate design and construction in the hands of J. H. Mendell, Superintendent. M. G. Ferry is the department civil engineer, and J. L. Wade is water registrar.

Contract and Day-Labor Road Construction Compared*

By R. W. Acton†

The choice between day labor and contract work for road construction in Minnesota depends largely upon local conditions of soil, topography, road mileage, etc., in the several counties. When counties are equipped with proper machinery, the light work on the prairies is handled more economically by day labor. But for heavy work involving large yardage the contract system is more economical. Where it is necessary to search the locality for sufficient material to build a road for $2,500 per mile, it is nearly impossible to estimate cost, and reliable contractors must bid so high to insure a profit that ordinarily it is advisable to organize a day-labor force.

There are three classes of road work that should not be done by contract—work that involves continuous classification, experimental work and work that cannot be definitely specified. The writer also questions the advisability of attempting to contract any road making that involves a grading cost of less than $500 per mile. Such construction is especially adaptable for blade-grader and tractor machinery, the investment in which is an asset to the county, but may become a liability to a contractor with the completion of his contract. Small jobs out of line of the day-labor crew, while running to high unit costs, may sometimes be handled more economically by the small local contractor.

For roadbuilding let by contract the overhead expense is a small and profitable item when it involves supplying the bidders with a clear and definite plan, specification and quantity of work and a definite knowledge of the conditions. The overhead expense is as essential to a low unit cost on day-labor work as on contract work.

Classification of Highway Construction

Highway construction in Minnesota costs from $1,500 to $4,000 per mile. The work may be divided into five classes—clearing, grubbing and grading, culverts, bridges and surfacing. Clearing and grubbing are easily let by contract and should preferably be handled in this manner, but should not be let separately from the grading. In combination a material reduction in overhead charges may be secured upon the clearing and grubbing, and a reduction in the unit price for grading will be obtained in addition to the avoidance of conflicting interest between contractors.

Portable culverts of concrete pipe, cast iron or corrugated metal should be purchased on definite specifications. Their installation should be included in the grading contract. The straight contract for monolithic concrete culverts is often a failure, owing to insufficient supervision, to failure of the contractor to realize the importance of a structure comparatively buried underground and to the failure of supervising boards to realize the importance of first-class workmanship. Better results have been obtained with the county furnishing the materials and letting a contract by the cubic yard for placing. Bridges are ordinarily let by contract.

Road surfacing is governed by local conditions. When gravel pits are available in which the contractor may place a loading device, economy may be obtained by letting contracts. When pits are pocketed, streaked and indeterminate and mechanical loaders are not conducive to securing the best gravel in the pit, a flat contract is not economical for the county. Low unit costs have been obtained by using day-labor crews in developing and loading out from these inferior pits and contracting for the actual haul.

The contractor's liability should cease with the delivery of gravel. The maintenance cost to insure a compacted surface is so indeterminate and is so dependent upon the quality of gravel and the weather conditions subsequent to placing that a contractor cannot make an intelligent bid on this item. Provision should be made for this maintenance by day labor.

Five methods or forms of contracting have been used on road work in Minnesota, as follows: Lump sum, cost plus percentage, unit price, combination of lump sum and unit price, and contracting for an outfit on a *per diem* basis, wherein the contractor guarantees a minimum yardage per day. The first two have proved the least satisfactory. Unit costs on such lump-sum work have

*Abstract of a paper read at the annual meeting of the Minnesota Surveyors and Engineers Society, at St. Paul, Minn.

†Division Engineer, State Highway Commission, St. Paul, Minn.

averaged much higher than under any other form of contract under the writer's observation.

The cost-plus-percentage method is more satisfactory in theory than in practice. Too often the county is paying for the experience of the contractor, in which situation there is no advantage over the rental of equipment and performing the work by day labor. However, where the percentage cost actually goes toward the purchase of experience, this system should be very acceptable.

Outfit on Per Diem Basis

The method of contracting for an outfit on a *per diem* basis, with a guaranteed minimum yardage, has been found successful locally and is applicable in conjunction with day-labor work only. The combination of the lump-sum and unit price is a compromise that has been read into the statute governing certain public work under which lump-sum contracts are prescribed. As applied to road work, the contractor is required to bid upon unit prices for each and every item or classification of work. The unit prices determine the amount of the contract and also form the basis for settlement for extra work or deductions.

By carrying a contingency fund it is possible to secure very satisfactory results with this form of contract. It is the most satisfactory plan on bond-issue work when a form of lump-sum contract must be used to comply with the law.

The unit-price method is ideal from the engineer's and the contractor's point of view. It is the fairest method of contracting and tends toward the lowest possible unit bid. Contractors feel safe in that omissions of sufficient quantities in the original estimate and revisions in compliance with the engineers' instructions or with the desires of supervising boards can be made without a question as to the method of final payment. The principal objection lies with the supervising boards, who feel that there are not sufficient restrictions upon the engineer.

Disadvantages of the Contract System

On the small job the inefficient and inexperienced man who must make contracting a side line rather than a business has placed contract work in disrepute. On the large jobs the contract broker has contributed to the same results. The objections are more apparent than real from a strictly economic point of view.

The letting of a contract to an unreliable contractor is not a fault in the contract system, but an error of judgment on the part of the supervising boards. Lack of efficiency and experience with the small contractor is a matter for correction by education. This possibly may involve a high cost in supervision. But the small scattering jobs must continue for several years, and with patient effort upon the part of the engineers and supervising boards these small contractors will become a valuable asset to the community.

The contract broker, who assumes the liability of the execution of a road contract with the purpose of scalping a profit from a following of subcontractors, claims that his profits are a legitimate expense covering his risk for assuming the liability and furnishing a bond. But in practice these profits are entirely out of proportion to the profits for the actual performance of the work.

The condition may be overcome by coöperation between the engineer and supervising board in splitting up a large project into several subdivisions. By an investigation of the contracting field it is possible to bring these subdivisions to dimensions that will not be detrimental to the project and will at the same time open the work to the greatest possible competition from contractors who intend to place a working organization on the job.

Another difficulty is the inexperienced contractor who can furnish a certified check, a surety bond and a bid so low that it is impossible to perform the work at the bid prices. Engineers may protest the letting of such a contract, but supervising boards will insist upon the low bid; and so long as a bond is furnished, there seems to be no other method of determining responsibility. This feature is becoming less objectionable as the surety bonding companies are becoming more wary.

Comparison of Contract and Day-Labor Work

The most frequent objections to contract work are the high cost of supervision, the desire to eliminate contractor's profit and the high cost as compared with the low cost of day labor. The apparently low cost of day labor, however, is too often the result of lack of proper supervision, with a consequent lowering of the standard of work to which the contractor would be required to adhere. If auditing was applied as rigidly to the day-labor system as to contract work, it would often reverse the final conclusions.

Eliminating the contractor's profit for the purpose of constructing a greater road mileage is only possible when the county can work up an organization as efficient as that of the contractor. Ordinarily, when competent management is employed for building up such an organization, a necessary waste of energy must at once be expended to overcome political interference.

Experience has shown that the unit prices obtained on the contract system are as low as those on day-labor work under ordinary working conditions and that contract work is conducive to a higher standard of construction than is obtained under the day-labor system. The educational value obtained from efficient contract work has compensated for the contractor's profits thus far.

The conclusions are that there must be a combination of both day-labor and contract work. Contract work under reasonably fair conditions is successful, and to obtain the same degree of success on the day-labor system requires the employment of the same efficient organization by the county as by the contractor.

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A 3.4-Mi. Power-Transmission Cable has been laid from Palsjo, Sweden, to Marienlyst, Denmark, as a trial installation. At Helsingborg the power is taken at 50,000 volts from the power lines of the South Swedish Power Co., stepped down to 25,000 volts and sent 3 mi. to Palsjo by an underground cable. On the Danish shore a mile of underground cable leads to a transformer station near Elsinore. Here the current is stepped up to 50,000 and transmitted down the coast for some 21 mi. by the North Zealand Electric Co. To protect the power cables from dragging anchors, a parallel steel protecting cable has been laid. To mark the crossing and warn navigators, steel towers 13x20x82 ft. have been erected, covered with white boards and lighted at night by green lamps. The power cables have three copper conductors, each of 0.109-sq.in. cross-section area insulated with 0.50 in. of impregnated paper, inclosed in a lead sheath and armored with galvanized Z-wires. The exterior diameter is about 3½ in. and the weight about 56 lb. per yd. This cable will be tried for a couple of years; and if satisfactory, two more will be put down. It will be recalled that at this crossing a direct-current 20,000-volt line (Thury system) was projected a few years ago (see "Engineering News," Mar. 27, 1913, p. 617.)

Rebuilding Barge Canal at the Irondequoit Break

By Emile Low*

On Sept. 3, 1912, a large break occurred in the newly constructed part of the New York State Barge Canal at the crossing of the Irondequoit Creek culvert, about 11 mi. east of Rochester, N. Y. The break and its subsequent temporary repair were fully described in *Engineering News*, beginning Sept. 19, 1912, p. 548, and continuing in a number of issues thereafter. At this location the canal was carried in a reinforced-concrete trough 96 ft. wide and 16 ft. deep, on an embankment about 60 ft. high. This embankment was for a part of its length of many years' standing, but at one end had been recently built for the new canal alignment. The break occurred entirely on the old embankment over an old culvert which had been repaired a number of times and which at the time of the accident was being lengthened. The canal was carrying 12 ft. of water, and the failure was due to the washing out of the embankment for a length of about 500 ft. following the rupture of the concrete trough. This rupture was undoubtedly caused by the settlement of the fill over the old culvert, the foundations of which had been weakened by the inflow of groundwater.

The work of repairing the break was commenced within a few days of the accident and consisted mainly of refilling the washout with sand, the only available material in this section of the country, and building a timber flume supported by piles driven into the new fill. This flume was thoroughly waterproofed and was built to a width of 21 ft. and a depth of 7 ft., sufficient to carry the traffic which was then running through the Erie Canal. The concrete trough at each end of the break was dammed off for the entrance of this narrow flume into the wider canal section. The flume served the purposes of navigation during four seasons—1912, 1913, 1914 and 1915.

Various plans for permanently repairing the break were suggested and a number of plans made. One was the building of a concrete aqueduct with five or more arches. This suggestion was subsequently abandoned in favor of a scheme to build a new culvert alongside the old, replace the old embankment and rebuild the concrete trough with some slight modifications. In conformity with this decision an arrangement was made last fall by the Superintendent of Public Works with a firm of contractors, Myers & McWilliams, to remove a portion of the timber flume, excavate a large part of the old embankment down to water level, build a new double-box concrete culvert and replace the embankment to El. 446 ft., or 19 ft. below the finished top of the embankment.

After this is done, it is intended to rebuild the torn-out portion of the timber flume and to leave the canal at this point in the same condition during the season of 1916 as it has been in during the past four seasons. Beginning then in the fall of 1916, after the canal is shut down, the timber flume will be torn out and replaced by a reinforced-concrete trough section of full width and depth.

Soon after the close of canal navigation in November, 1915, operations to this end were begun. At the present time the embankment has been cut in two, making a V-shaped hole of large dimension, shown in the accompanying views. The width of the new excavation (along center line of Barge Canal, right angles to axis of culvert) on top is about 200 ft., at bottom about 40 ft., and the depth below bottom of trough about 60 ft. The upper portion of the cut, about 30 ft. deep, was made by the revolving derrick running on trestle work, with drag buckets, the material being deposited right and left of the embankment. The lower portion, also about 30 ft. deep, was mainly removed by steam shovel. Revolving derricks were also used near the bottom.

The work of driving the wooden foundation piles for the new culvert is in progress. Locomotive cranes with steam-hammer attachments on the boom are used. The piles are driven inside a coffer-dam of Lackawanna steel sheetpiling, and the coffer-dam is kept unwatered by centrifugal pumps located at the north end of the new culvert. The high trestle built into one side of the excavation supports the tracks for the derrick sup-

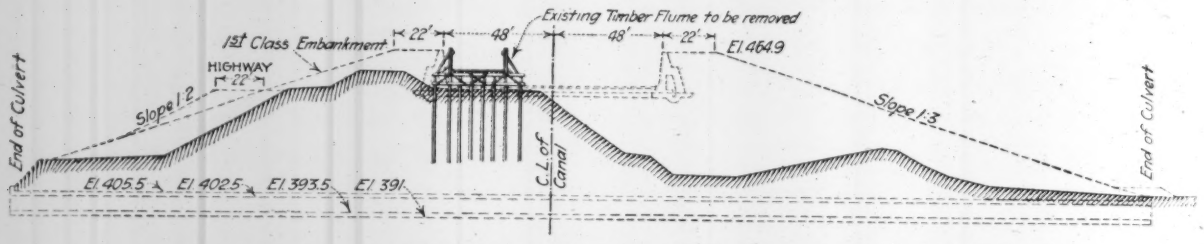

FIG. 1. SECTION THROUGH IRONDEQUOIT FILL OF NEW YORK STATE BARGE CANAL
Dotted lines show future permanent construction

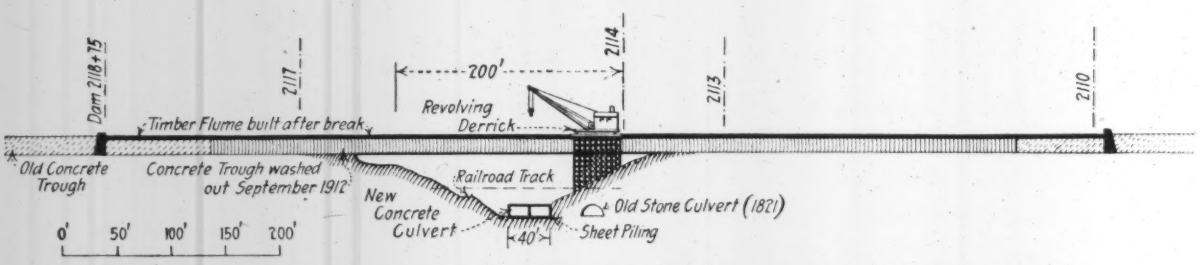

FIG. 2. LONGITUDINAL SECTION THROUGH EMBANKMENT, SHOWING REPAIR WORK

*745 Lafayette Ave., Buffalo, N. Y.

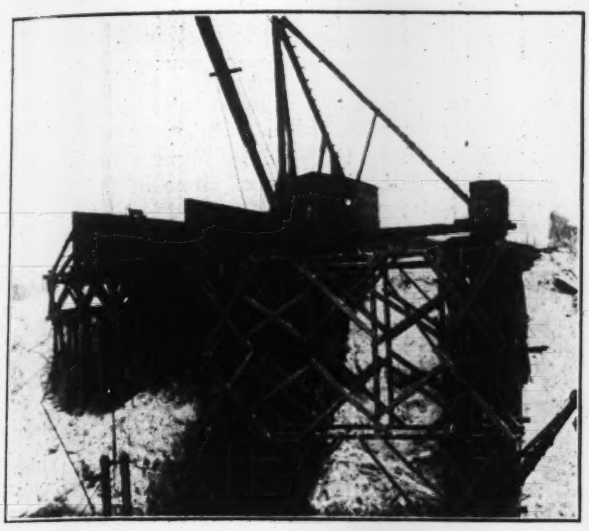

FIG. 3. LOOKING EAST TOWARD OLD TROUGH AND NEW CONSTRUCTION TRESTLE

plying the construction materials for the new work. Sand and gravel abound in large quantities near the building site, and the gravel washer and concrete mixer previously used on this contract are used on the present work, as also are the steam shovels, dump-cars, railroad tracks and machinery yet remaining.

The new culvert has a length of 500 ft. and is of a square double-box reinforced-concrete section. The work is being done by force account and includes everything below El. 446. Above that the permanent work is comprised in a new contract, for which bids were opened on Feb. 16, 1916, the State Highway Construction Co., Beacon, N. Y., being low bidder at $188,103. The reconstructed concrete trough is included in this new contract, but differs from the old one in that inspection galleries are provided and 4-in. tile drains leading to them will take any escaping water to two manholes—one in the north and the other in the south end. Here, a 12-in. sluice valve is located, and the accumulated water is carried down the slope in a 12-in. cast-iron flexible-joint pipe. There will be also modifications of the floor of the trough, two layers of concrete separated by screened gravel with the usual tar felt waterproofing being provided. The new trough will be 700 ft. long.

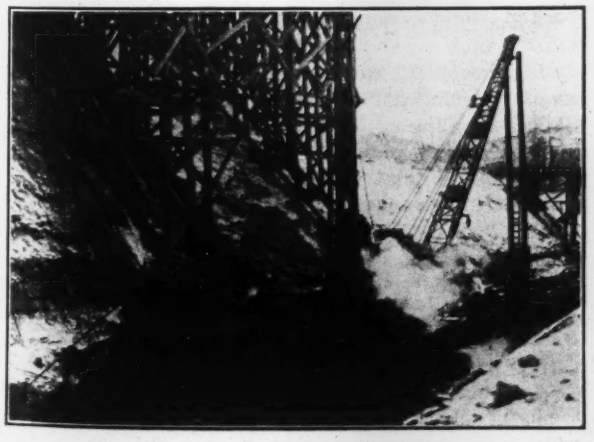

FIG. 4. DRIVING CULVERT PILES IN BOTTOM OF CUT

Wood Against Steel Pipe in Seattle Water-Works

By John Lamb*

The period of efficient service and the relative cost of installation and maintenance of wood-stave and steel riveted pipe have been matters of much interest for some years past to both engineers and water-department officials in many sections of the country. It is a matter of great importance when we consider the millions of dollars invested in pipe lines and the millions more that are yet to be invested.

The two water-supply conduits from Cedar River to the City of Seattle, Wash., have a combined length of 62.61 mi., 50.47 mi. of which is wood stave and 12.14 mi. steel riveted.

After 15 years in the ground (which for the most part consists of sand, gravel or what is known as "shot clay"—clay mixed with gravel) the steel pipe when stripped shows considerable evidence of rust where the asphalt coating has been injured in handling and also in spots under the coating, where rust had taken hold previous to the repainting.

The wood staves began to show evidence of decay in about 7 years after installation; but the deterioration was very irregular, depending partly on the nature of the soil (the sections in gravel going first), partly on the degree of saturation due to head and partly, in fact quite largely, to defective material in the staves. It is found that two staves side by side may show great variation in the degree of decay. For this reason the repairs sometimes require the replacement of a few staves and sometimes the removal of a considerable section of pipe.

The process of renewal is quite simple. The new staves, which are now coated before installation with two applications of conservo or creosote, are furnished in lengths from 10 to 30 ft. A form of invert corresponding to the outside semidiameter is used upon which to lay the lower staves. On this form the staves are built up to the horizontal diameter and driven to place endwise; the upper staves thus rest upon the lower ones and are held in place partly by the steel bands and partly by the projecting ends of the staves at the semifinished end of the pipe while being driven to position. The principle of broken joints is used in all construction.

The cost of original installation of the 42-in. wood pipe, with labor at $2 to $2.25 per day, was $3.507 per foot. The cost of renewing the staves varies with the cost of labor, the difference in excavation cost and the spacing of the bands. With wages of common labor at $3 per day the cost will vary from $1.50 per foot where the number of bands is 1 per foot to $2.25 where the bands run 6 to the foot.

Philadelphia Electric Rates will be generally reduced some 12% as the result of a compromise in the action between the City of Philadelphia and the Philadelphia Electric Co. before the Pennsylvania Public Service Corporation. It has been agreed to reduce rates (proportionately for all classes of business) on the basis of cutting $1,000,000 from the 1915 gross earnings of $7,849,267. The company's annual surplus for 1915, after paying dividends, was $763,000. The case has been running since November, 1914, and valuations have been made by D. C. & W. B. Jackson, Sanderson & Porter, W. McClellan, M. R. Maltbie and F. W. Ballard. The company's stock rose on the announcement, owing to prospects of increased business more than offsetting the reductions.

*Auditor, Water Department, Seattle, Wash.

Beams Without Lateral Support

By R. Fleming*

The percentage of the tabular safe loads for beams supported sidewise to be used for beams not so supported is given in the Bethlehem, Jones & Laughlin, Phœnix, Cambria and Carnegie handbooks as follows:

Handbook	Ratio of Span to Flange Width: 10	15	20	25	30	35	40	50	60	70	80	90	100
Bethlehem, Jones & Laughlin, Phoenix	100	100	100	95	90	85	80	70	60	50	Table stops		
Cambria	100	100	99	93	87	80	73	61	51	43	36	30	26
Carnegie	100	91	81	72	63	53	44	Ratios above $\frac{l}{b}$ not allowed					

Considering the wide divergence of strength shown in this table, a review of the subject may be of interest. It is well known that the compression flange of a beam is not a simple column—the flange stress is not a maximum throughout the whole length, and the top flange receives some support from the web and the tension flange.

The first values in the table have been used more widely than any others. In the Pencoyd book, "Steel in Construction," 1884, edited by James Christie, there are the following paragraphs:

Our experience has been that a beam without lateral support is more stable than is commonly supposed. In an open-webbed beam the top flange acts as a simple strut and is liable to lateral flexure when the unsupported length is considerable. But in a solid beam the parts in tension sustain the parts in compression and prevent the buckling that would otherwise occur.

Experiments have shown a reduction of about one-third of the normal modulus of rupture when the length of the beam becomes 80 times its flange width. But as the long beam may suffer if exposed to accidental cross-strains, we recommend the greatest safe load to be reduced in such a ratio for long beams that when the length is 70 times the flange width the greatest safe loads will be reduced one-half. This will give safe loads, corresponding to given lengths, as follows:

BEAMS WITHOUT LATERAL SUPPORT

Length of beam	Proportion of Tabular Load Forming Greatest Safe Load
20 times flange width	Whole tabular load
30 times flange width	9/10 tabular load
40 times flange width	8/10 tabular load
50 times flange width	7/10 tabular load
60 times flange width	6/10 tabular load
70 times flange width	5/10 tabular load

As long as it was published, the Pencoyd book retained these paragraphs. The table will be found in editions of the Carnegie "Pocket Companion" for 20 years previous to 1913. It is still given in the handbooks of the Bethlehem Steel Co., the Jones & Laughlin Steel Co. and the Phœnix Iron Co. It is given also in Kent and Kidder and is quoted by many writers. What Mr. Christie said 25 years after it was published will be a surprise to most readers[1]:

Some experiments were made on beams of considerable length in proportion to cross-section and without lateral support, the object being to ascertain approximately how the working loads should decrease as the length of the beam increased. As I remember it, the results of these experiments were unsatisfactory, and although tables were formulated suggesting a scale of reduction for loads on long beams without lateral support, yet these tables had neither a rational nor an experimental basis, but were derived by a general estimate of probabilities. For long beams, when the beam is reasonably straight and its load free from vibration, a large load appeared to be safely borne. But this was not the case when lateral vibrations were set up. The long beam, heavily loaded, appeared to be in a state of unstable equilibrium.

In obtaining the second series of values, it is assumed that the top flange of a beam acts as a column and the section is a rectangle of width b. The square of the radius of gyration is $\frac{b^2}{12}$. For the reason that the top fibers are partly held by the fibers below, a unit stress of 18,000 is used instead of the ordinary 16,000 for simple columns. Using the Rankine formula for columns with fixed ends, the intensity of stress in the extreme fibers is

$$S_c = \frac{18{,}000}{1 + \frac{l^2}{36{,}000r^2}} = \frac{18{,}000}{1 + \frac{l^2}{3{,}000b^2}}$$

This is the Cambria formula, by which the allowable fiber stress for any ratio $\frac{l}{b}$ may be obtained. The ratio of the stress thus found to the ordinary unit stress is the percentage of tabular load for beams supported laterally that can be used for beams not so supported.

If $r^2 = \frac{b^2}{12}$ or $r = \frac{b}{3.46}$ be substituted in the American Bridge Co. compression formula $S_c = 19{,}000 - 100\frac{l}{r}$, we have $S_c = 19{,}000 - 346\frac{l}{b}$. Making an arbitrary reduction and using round numbers, $S_c = 19{,}000 - 300\frac{l}{b}$. The Carnegie values are based upon this equation.

An English handbook, Skelton, "Structural Steel," 1915, rules that if the top flange of a girder is not supported sidewise at intervals of less than 20 times the flange width, the working stress should be reduced. "It is considered good practice to reduce the stress by a percentage equal to the ratio of span (or free length) to breadth less 20, namely, $\left(\frac{l}{b} - 20\right)$ %." This is but another way of expressing the values of the Pencoyd table.

Hudson, "Plate-Girder Design," 1911, suggests $S_c = 16{,}000 - 200\frac{l}{b}$. Kunz, "Design of Steel Bridges," 1915, writes: "The formula $16{,}000 - 70\frac{l}{r}$ for the permissible stress in ordinary columns may therefore safely be replaced by the formula $16{,}000 - 50\frac{l}{r}$ for the stress in the compression flange of girders." This is equivalent to $16{,}000 - 173\frac{l}{b}$.

Other formulas have been followed in the past, but they have largely fallen into disuse. The 22-page handbook, "Rolled Iron Beams Made by the New Jersey Steel and Iron Co.," was a pioneer in its line. From a rare copy, dated 1871, is taken the following:

Beams Unsupported Sidewise—To find the coefficient for strength when the beam has no support sidewise between the bearings upon which it rests. Rule: Multiply the coefficient for strength in column VI of the preceding table by the number given in column IX in the table on next page, headed "Correction for Lateral Deflection," and divide the product by the number in column IX, plus the square of the span taken in feet.

It is not stated how the "Correction for Lateral Deflection" was obtained.

The handbook of the Passaic Rolling Mill Co., dated 1884, gives a table of the "Safe Load, in Tons, for Beams

*American Bridge Co., 30 Church St., New York City.

[1] "Proceedings" of the Engineers' Club of Philadelphia, Vol. XXVI, p. 111, April, 1909.

Unsupported Sidewise." We read, "This table is calculated from Rankine's formula,

$$b = \frac{a}{1 + \frac{l^2}{5{,}000w^2}}$$

in which a = the strain in beams braced sidewise, l = length in inches, and w = width in inches."

The Pottsville Iron and Steel Co. in its "Handbook," 1887, uses the same formula for its reduction table, assuming the numerator in the second term to be equal to one-third the modulus of rupture.

Contributions to the Theory of the Problem

In the *Philosophical Magazine,* Vol. XLVIII, pp. 298-309, September, 1899, there is a paper, "Stability of Long Beams Under Transverse Forces," by A. G. M. Mitchell, of Melbourne, Australia. Although the author's experiments on a steel straight-edge verified to a remarkable degree the results he had obtained by theory, the formulas developed are not applicable to structural shapes.

The book, "Experiments on the Flexure of Beams: Discovery of New Laws," 1903, by Albert E. Guy, is a reprint of the author's articles in the *American Machinist.* The experiments, made with diminutive wood flats, add little to our knowledge of the lateral flexure of I-beams.

A paper, "Lateral Strength of Beams," by H. D. Hess, is published in the "Proceedings" of the Engineers' Club of Philadelphia, Vol. XXVI, 1909. (It was the discussion of this paper that drew from Mr. Christie the remarks previously quoted.) In the ordinary column the load is uniform throughout, while in the compression flange of a beam the stress varies from zero at the supports to a maximum value at the center of the span. Hess obtains the length of a column which is equivalent to the compression flange. The percentage of tabular load to be used for beams uniformly loaded and unsupported sidewise varies according to his equations from 99 for $\frac{l}{b}$ = 10 to 58 for $\frac{l}{b}$ = 50.

A paper, "Tests of Standard I-Beams and Bethlehem Special I-Beams and Girder Beams," by Edgar Marburg, in the "Proceedings" of the American Society for Testing Materials, Vol. IX, 1909, came as a shock to designers of steel structures by reason of the low values recorded of the elastic limit. A number of 15-in., 24-in. and 30-in. beams supported at the ends and unstayed laterally were tested for bending. The span, center to center of end supports, was 15 ft. for 15-in. beams and 20 ft. for 24- and 30-in. beams. The standard beams failed in every instance by "lateral deflection of top flange," showing an elastic limit averaging only 20,000 lb. The Bethlehem beams failed by "twist of web" and showed a higher elastic limit for 15-in. beams, but lower for larger sections. A comparison with tabular loads based on a working fiber stress of 16,000 lb. is precluded by the fact that test pieces cut from the compression flange and root showed elastic limits from 11,000 to 33,000 lb. in pure tension. Professor Marburg says in his paper, "The number of tests are not sufficient to warrant definite conclusions."

In the paragraph, "Failure of Beams Due to Flexure on the Compression Side," in Boyd's "Strength of Materials," 1911, the Cambria formula is deduced.

Bulletin No. 68, Sept. 1, 1913, of the University of Illinois Engineering Experiment Station is a monograph, "The Strength of I-Beams in Flexure," by Prof. Herbert F. Moore. For buckling of compression flanges of I-beams Professor Moore, like Hess, finds an equivalent column length. He summarizes:

> The computed ultimate fiber stress for steel I-beams not restrained against sidewise buckling of the compression flange is given by the formula,
>
> $$F_1 = 40{,}000 - 60\frac{ml}{r'}$$
>
> in which F_1 is the extreme fiber stress, in pounds per square inch, computed by the usual flexure formula, l is the length of span of beam in inches, r' is the radius of gyration of the I-section about a gravity axis parallel to the web, and m is a coefficient dependent on the method of loading, ml being a so-called equivalent column length.

The value of m for a simple beam with uniform load is given as 0.667, and with load at mid-point as 0.500. For primary failure by sidewise buckling 15 tests were made on 8-in. I-beams of spans from 5 to 20 ft. The extreme values observed fell within 2,500 lb. per sq.in. of the values found from the formula. Regarding some tests to failure of 8-in. beams restrained from twisting of ends, the author writes: "For all except the short-span I-beams the fiber stresses developed at failure by beams restrained from end twisting did not differ appreciably from the fiber stresses developed at failure by the beams not so restrained. Failure for both kinds of beams occurred by sidewise buckling, and it would seem that restraint of ends of I-beams against twisting does not appreciably increase their resistance to sidewise buckling."

This may be true of shallow beams, but it is doubtful if it is so of deeper ones where the web receives little or no stiffening support from the bottom flange.

New Reduction Formula Recommended

From the foregoing it will readily be seen that proposed formulas for reduction rest upon neither accurate theory nor adequate experimental data. The formula, $19{,}000 - 300\frac{l}{b}$, upon which the Carnegie values are based probably errs on the side of safety.

The writer suggests that $19{,}000 - 250\frac{l}{b}$ be used when the lateral unsupported length exceeds 12 times the width of the compression flange. The length should in no case exceed 50 times the width of the compression flange. Of course this applies to static loads only. For beams used as crane-runway girders, provision must be made for horizontal thrust, often assumed to be $\frac{1}{10}$ the lifting capacity of the crane.

Government Calls for a Percentage Bid—The specifications covering alterations to building No. 172 at Indian Head, Md., bids for which were recently opened by the Bureau of Yards and Docks, called for these bids under two items as follows: Item 1, estimated outside price of work; Item 2, net per cent. of cost for which bidder agrees to perform the work. The specifications state: "Payments will be made monthly based on certified net bills for materials and payroll for labor, checked and approved by the officer in charge. The contractor will be required to furnish a bond guaranteeing the amount named in Item 1. In case the cost shall exceed the amount named in Item 1, the contractor shall complete the work at his own expense without any per cent. compensation in excess of the amount named. The material and labor are to be covered by Item 1, but office expenses, overhead charges and contractor's profit shall be included in the per cent. stated in Item 2." This proposal was called to the attention of "Engineering News" because of the unusual fact of a per cent. bid being asked by the Government. It is alleged that the only other proposal of this character in recent years by the Government was the Panama Canal bid of 1907.

Concrete Sheet-Pile Groin at Long Branch, N. J.

By J. W. Seaman*

Long Branch, N. J., is situated on the Atlantic coast about 10 miles south of Sandy Hook and 3 miles below Sea Bright, which was nearly wiped out by the sea during the last two winters.

About 10 years ago this city built a wooden bulkhead along the ocean front a distance of 2 miles, with a complete system of wooden groins extending out into the ocean 125 ft. and spaced 300 ft. apart. These have protected the ocean front since that time, but are now decaying. In a few years all will have to be replaced at a large expense. At Sea View Ave. a wooden groin was built about 5 years ago, but the teredo has so eaten the material that it has been found necessary to build a new one. Concrete has been selected as the material. This new groin has been completed a distance of 125 ft. and has proved so satisfactory that the Board of Commissioners has decided to extend it 25 ft.

The general construction of the groin (Fig. 1) consists of concrete piles placed side by side, with a concrete cap placed after they are in place. The piles are 14x14 in., 26 ft. long and are made in proportions of 1 of cement and 4 of sand gravel, reinforced with four ¾-in. twisted steel rods placed about 2 in. from the surface. Each pile was pointed at the end, so that it would fit up tight to the adjoining pile. The most important feature in the design was the tongue and groove, for groins are useless unless made sand-tight. They were made with the groove the full length of the pile on one side; on the other side they had a tongue from the point up a distance of 14 ft. and a groove from there to the top of the pile. A small pocket was also made in each pile at the top, which was filled with concrete at the same time the cap was put on. The piles were put in with the water jet in the usual manner and set as close and tight as practical. The spaces between the piles were then calked and the sand and water pumped out of the grooves between the piles, which were filled with concrete. The cap, which extended 2 in. on each side of the piles, was then put in place, boxed in and made water-tight, so that when the tide rose, the concrete would not be affected. A platform was erected level with the boardwalk (Fig. 2), and upon it a derrick was used to put the piles in place.

*City Engineer, Long Branch, N. J.

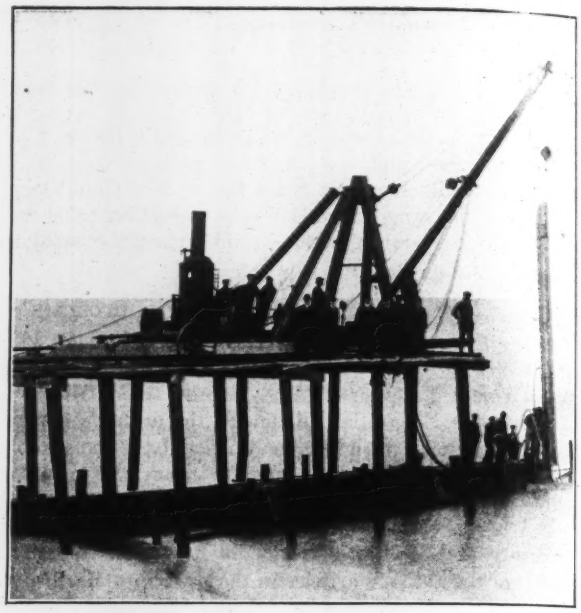

FIG. 2. SINKING ONE OF THE PILES IN THE GROIN

FIG. 3. LOOKING ALONG THE BULKHEAD AT LONG BRANCH TOWARD NEW GROIN

Sand has built up as shown in the foreground since new groin (which runs under the staging) was built

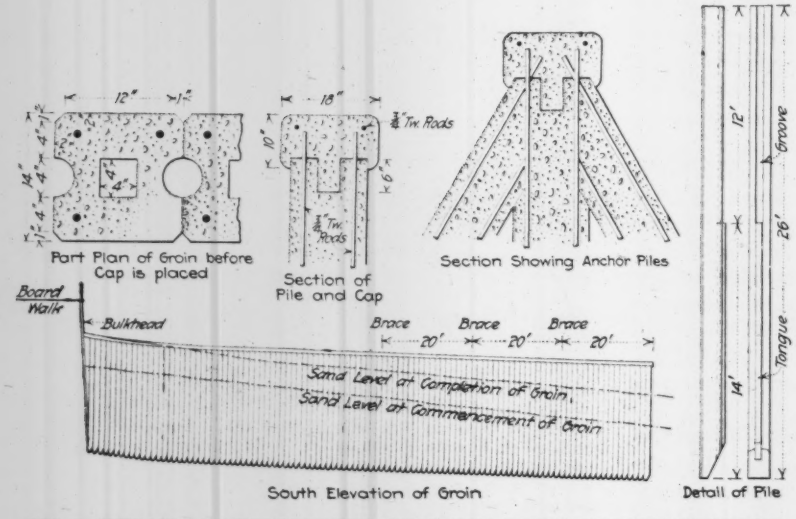

FIG. 1. DETAILS OF REINFORCED-CONCRETE GROIN RECENTLY PLACED AT LONG BRANCH, N. J.

The groin was braced on the outer end and at points 20, 40 and 60 ft. respectively from the end with brace piling on each side, as shown in Fig. 1. The bracing was considered necessary at this location, as just north of it Ocean Ave. is washed away and the sea has eaten in about 200 yd., so that the current is very swift at this point, causing deep erosions during storms.

When the groin was started at the bulkhead, the top was about 7 ft. above the sand level. As it extended eastward, the sand made up very fast, so that at the time it was completed the beach was up to its top at the inshore end. Fig. 3 shows in the fore-

ground the present beach just south of the new groin and in the background the beach at the beginning of the work. The groin cost $27 per lineal foot. The work was done by Thomas Proctor, contractor, Long Branch, N. J., under the direction of Commissioner John W. Flock and under the writer's plans and supervision.

Valuation of Water Rights for Power Companies

By J. P. Newell*

In this paper an attempt is made to show that water rights, like other property, are valuable in accordance with their power to produce revenue, but that in estimating this capacity the rights must not be credited with values arising from privileges granted solely for the purpose of enabling the grantee to serve the public.

Some of the most perplexing problems in the appraisal of public utilities arise in the valuation of water rights. On the one hand, utilities sometimes claim under this head an amount sufficient to make up everything they have been obliged to give up on other accounts. On the other hand, there is a tendency to deny any value to such rights, on the ground that they are granted solely for the public benefit.

The subject requires a different treatment in the Western States from that which it receives in other parts of the country. Along the Atlantic slope it has long been customary to determine the value of a water right by capitalizing the annual saving by the use of the water-power as compared with a steam plant of equal capacity. But this method fails entirely in the Northwest, where water is the principal source of power and where most of the power produced for sale is sold under public-service conditions.

Two Principles Observed

In the valuation of public utilities two basic principles must be observed: (1) The "fair value" of property devoted to public service is the highest value that can be found for the property in any use, public or private; (2) The values arising from privileges granted by the public for the sole purpose of serving the public cannot be made the basis of charges against the public.

Privileges granted by the Government to individuals or corporations are of two main classes. The first includes grants of the right of eminent domain, permits to occupy streets with tracks, pipes or wires and the like. These all come under the head of franchises. They are given solely for the purpose of enabling the grantee to serve the public. They cannot be used except in public service. They are not granted for private use, and any profit arising from them is purely incidental. There is a growing tendency among courts and commissions to deny any franchise value in rate regulation, except under unusual circumstances.

The second class consists of permits to appropriate water, to take up homesteads, to file on mineral claims, to buy timber lands at nominal prices, etc. These privileges are granted with the expectation that the public will benefit by them, but the public benefit is incidental to the benefit to be received by the grantees. There is no condition attached that the property shall be used for the public good. The owners may and are expected to put the property to use for private profit. It is true that the appropriator of water must continue to use it if he would remain in possession. The appropriator of a homestead is required to live on it and to improve it for five years. This provision was made to insure continuous use of the property. A more stringent provision has been made to obtain the same end in the case of water, but the underlying principle is the same. The right to use water for private profit is as undeniable as the right so to use land. It would therefore be as unjust to deny the right to compensation for the public use of the one as for that of the other.

Ability To Produce Income

The value of property whose function is to produce income can be measured only by the income. Where the property, by the possession of certain rights or privileges, is enabled to earn an amount in excess of the normal return on the investment, such excess measures the value of the right or privilege. The appropriator of water for power purposes, through the privileges granted by the state and the conditions resulting from the growth of the community, is sometimes enabled to earn a return greater than the normal return for investments of equal hazard. This excess represents the value of the water-power rights.

In the appraisal of water-power rights it is difficult to separate the water from the appurtenant land. Neither one alone produces the value. The development of power is made possible by the combination of water in sufficient quantity with land of such configuration that the water may, at reasonable cost, be taken from the stream at one elevation, be caused in falling to operate machinery and be returned to the stream at a lower elevation. It is customary to determine the value of the water and the land thus combined, subtract the value of the land and consider the remainder as the value of the water rights. This value may and often does include other intangible values, such as strategic location, unusual skill in construction or efficiency in operation; but it is difficult to separate them, and no injustice arises from their inclusion.

The economist's "real value" depends on the income, and the income on the rates. Hence, if the rates depend on the value, we have completed the circle and the problem is found impossible of solution. But the "fair value" of a utility is something distinct from this "real value," though related to it. It is something inherent in the property and the circumstances surrounding it. It is the value on which the owners are entitled to a fair return. To determine real value, we need know only present and prospective income and fair rate of return. The determination of "fair value" involves a judicial act. It requires that account be taken of investment, cost of reproduction, development cost, value for private use, strategic location, unusual skill or economy and any other elements of sacrifice or value for which the owners may properly expect compensation, or would receive it if applied to other activities. The result will bear no fixed relation to any of the elements named. It may be either greater or less than investment, reproduction cost of plant and business or amount of stocks and bonds.

Under ordinary conditions reasonable rates will be such as will yield a fair return on the value thus estab-

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lished; but if for any reason rates yielding such return would be unreasonable to the consumers or such as would cause them to decline service, the utility must be content with a less return and await the growth of the community, or charge off part of the investment to profit and loss.

If, on the other hand, rates may be such as will produce more than a normal return on the fair value and still be reasonable to the public, the utility is entitled to the increased return. In other words, "reasonableness" takes precedence over "fair return" in determining both the maximum and the minimum limits of the rates to be charged. It follows that in the appraisal of values we must add to the factors named one arising from the possibility of the income produced by "reasonable rates" in public service exceeding the amount required for a "fair return."

In determining the "fair value" of water rights the same principles govern as with any other property. Every fact relating to their actual or potential value must be taken into account. The elements of value affecting such rights are the cost of reproduction, or the expenditure which would be necessary to obtain the rights in their undeveloped state, the value for private use and the value in public service. In each case the rights must be considered both separately and in such combinations as are possible under the conditions assumed. The measure of value that gives the highest result is the one to be applied. The cost of obtaining water rights is reflected in the values assigned to the land.

Change from Private Service to Public

In considering the value that water rights would have in private use no weight should be given to the fact that the rights have become subject to obligations in the public service that forbid their being converted to private use. It is the duty of public-service commissions to insure fair treatment to both the utility and the public, and no conditions should be imposed on the owners that would not be imposed if they were free to put their property to either public or private use. They should not be compelled to accept less compensation for property devoted to public service than they could obtain in private service, if free to engage in it. Changes in the arts or in the markets may give great value to water rights that had little or no value when they were dedicated to the public use, and the owners ought not to be deprived of the resulting increase.

In determining the value of the power in private use it must be considered under strictly private conditions. The error commonly made is that of considering the possible income to be derived from sale for private use under conditions possible only in public service. The owners of a utility are entitled to receive in public service compensation equal to anything that they could earn by sale to private parties, but such sale must be possible without the public assistance.

Under private-service conditions it would be impossible to obtain the necessary permits to occupy public streets or roads or to purchase rights of way for transmission lines at a cost that would leave any margin for profit. The right of eminent domain alone could make financially possible the development of a water power at any considerable distance from market. The resulting value of the water-power as measured by an excess of income over a fair return would therefore be due to this factor contributed by the public. Such value would not belong to any property devoted to the public use by the owners of the utility and therefore could not properly be capitalized against the public.

In applying these principles to the appraisal of the water rights of a given power plant, it is necessary, first, to determine the cost of generation of power including a fair return on the "fair value" of the plant, exclusive of water rights. If this cost of production is exceeded by the revenue that can be obtained by the sale of the power without the assistance of public privileges, the excess measures the value of the water rights in private use.

If it can be shown that the power can be sold to the public at rates that are reasonable to the consumers and yet produce a return exceeding the cost of production, the excess measures the value of the water rights, as in public service.

Lastly, there must be ascertained the probable cost of obtaining the water rights if the power were undeveloped—in other words, their cost of reproduction. Of the results of these three calculations the highest will be the fair value of the water rights, though as already stated, there will probably be included other intangible values as well.

With but few exceptions water powers exist at a considerable distance from any point where their product can be used. Without the privileges granted by the public they are practically worthless. The public and the water-power producer are then in the position of two partners, each of whom possesses something indispensable to the other. Neither monopoly, therefore can be exercised against the other partner.

Drainage in the Dakotas

In South Dakota, when drainage districts are organized under the state law and the work is carried out through the boards of county commissioners, the projects are under the supervision of the state engineer's office (Homer M. Derr, state engineer).

A project of any importance is looked over by the state engineer in company with the county commissioners and interested landowners. If it is found to be feasible, it is customary for the state engineer's office to recommend the employment of a certain licensed deputy state surveyor. Surveys are then made, and plans and specifications are prepared. After these have been approved by the state engineer's office, the county commissioners proceed with the construction. Two projects now in hand have been thus approved—the Lake and Moody Counties project, of which Charles A. Trimmer, Mitchell, S. D., is engineer, and the Simpson Lake project in Aurora County, of which E. K. Mather, Mitchell, S. D., is engineer.

A considerable amount of drainage work of this kind is done each year. There is also much tile drainage by private parties, but the state engineer's office has nothing to do with that and receives little information respecting it.

In North Dakota there is reported to be considerable but intermittent activity in drainage ditch work. The ditches range from small sizes of farm drainage to ditches 5 to 6 ft. deep and of 15- to 25-ft. top width. There are some still larger. These ditches are built

usually by coöperative or individual effort, or more frequently by the drainage districts or county drainage boards, the cost being assessed against those benefited. They are located usually on the section or quarter-section lines, unless the topography is such as to make this impracticable.

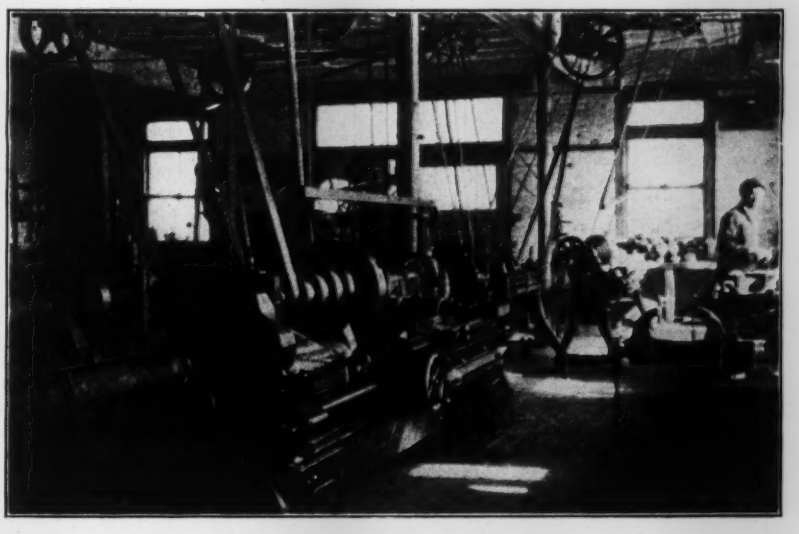
A considerable proportion of the surface drainage work now being done is the enlargement of ditches constructed several years ago. It is stated that there is a prevailing idea that farmers cannot afford the assessments necessary for a ditch of adequate size, and in consequence they have eventually to pay for it twice.

According to information received recently, there is very little tile drainage in North Dakota for farm improvement. Such work as has been done consists of small isolated jobs.

Large Water-Works Machine Shop at Los Angeles

By Burt A. Heinly*

In conformity with the policy of the Los Angeles Water Department to let nothing by contract that can be done cheaply and efficiently by its own organization, the machine shop which the department operates has been developed into one of the largest and finest water-works shops in the country. Part of it is shown in the view



INTERIOR VIEW OF MACHINE SHOP, LOS ANGELES WATER-WORKS

Originally starting with a forge, a small lathe and a drill press, this shop, with the growth of the water-works system and the advent of the automobile, has grown until now it occupies a two-story brick building 100 ft. long by 40 ft. wide. This building is centrally located at the water-works yards. The machine shop proper is 69 ft. long by 40 ft. wide and is equipped with three large lathes, screw presses, grinders, drill press and threading machine, driven by one 3½-hp. and two 3-hp. motors; a steam vulcanizer and a one-ton crane. Adjoining the machine shop itself and taking up the remaining ground floor space is the blacksmith shop, equipped with a power hammer and prepared to do the heaviest smithing that the department has. The second floor is given over to a paint shop, a wood-working shop and lockers for the men. The wood-working shop is equipped with power band and circular saws, planer and shaper.

The force comprises a foreman at $5 per day, three mechanics at $4 per day and two chauffeur-mechanics at $90 per month. The city maintains a municipal garage and machine shop that cares for about 140 cars, but the Water Department shop is owned and operated exclusively for its own work. As the department operates 66 automobiles, it will be seen that much of the time of the force is occupied on this character of work. The shop is well equipped for this special purpose and is prepared to assemble a car completely, even extending its operations to painting, but not including the finest class of varnishing.

All bodies for work cars are built in the shop. Most, or all, of the light repair, meter and leak wagons are Ford runabouts, for which new bodies are built to suit water-works needs. This change is made by the department at a cost of 40% lower than the automobile-factory price. Comparative figures on repair parts and supplies which, wherever standard, are purchased in quantity at dealers' rates, and private garage figures on installation show that the money saving accomplished by this branch of the service ranges from 15 to 120%. Convenience and dispatch, moreover, are savings in satisfaction that are not to be reckoned. The shop is ready at all times to tackle the most important job first; there is no waiting on the other fellow, and where necessity arises, the whole force remains on the job until it is finished.

In addition to automobile maintenance and all local water-works maintenance and construction, the mechanical force repairs all fire hydrants and gate valves, makes all gate-valve stems required and is subject to call to any one of the eight pumping stations where the repair or the need is beyond the ability of the station engineer. During the past seven years in connection with the construction of the Los Angeles aqueduct, and more particularly with the building of the hydraulic-fill dams and city trunk line, comprising the link that connects the aqueduct outlet with the city distribution system, there has been a large amount of machine and repair work incidental to the operation of the extensive sluicing and excavating equipment. All of this work has come under the supervision of the shop, which stands to the operating and construction end of the department as a sort of efficiency mechanical corps. With the installation of the 317 mi. of steel mains comprising the aqueduct irrigation distributing system, work on which is now starting, the need of such a well-equipped shop will become more apparent.

It will thus be seen that while the largest demands are made by the traffic end of the system, the shop is essentially designed for and does meet all the calls made upon it in the operation of a water-works system of over 1,000 mi. of distribution mains and 370 mi. of supply conduits.

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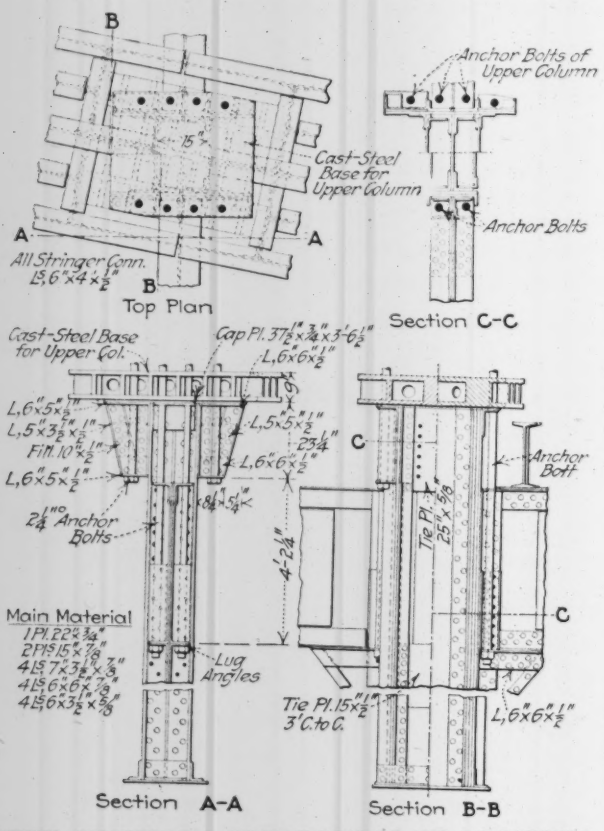
Heavy Steel Bridge Columns

Steel columns of very heavy construction are required by special conditions for the 79th St. subway on the Chicago track-elevation work of the Illinois Central R.R.

The subway has bents of steel columns and crossgirders supporting a deck of longitudinal I-beams. The New York, Chicago & St. Louis R.R. crosses the Illinois Central R.R. by an overhead bridge at this point, and some of the columns for the bents of this latter bridge come directly over the columns of the subway bridge. To carry this additional load, columns of special design are required. Each column of the subway rests on a concrete pier carried down to hardpan.

The main part of the special column consists of 3 web plates and 12 angles, the inner flange angles of the outer plates overlapping the flange angles of the central



STEEL COLUMN OF A SUBWAY BRIDGE AND SUPPORTING THE BASE OF A COLUMN OF A HIGH-LEVEL BRIDGE

plate. A flaring head, built up of angles and plates, carries a ¾-in. cap plate 37½x42½ in. Upon the head of the column is placed a cast-steel cap 57½x40½ in., 9 in. deep, forming the shoe for the upper-deck column of the high-level bridge.

This upper column is anchored to the lower column by eight 2¼-in. anchor bolts. Four of these pass only through the enlarged head of the lower column. The others extend downward for a distance of nearly 7 ft., and their ends pass through lug angles riveted to the crossgirder and the column.

Each column is 18½ ft. high from shoe to cap plate and weighs about 5 tons, exclusive of the cast-steel cap. The load on the base of the column (on the concrete pier) is estimated at 910 tons.

The subway design was under the direction of W. S. Baldwin, Chief Engineer of the Illinois Central R.R. The steelwork that carries this railway was fabricated by the American Bridge Co. and erected by the Ketler-Hoff Construction Co., Chicago. The steelwork for the high-level bridge of the other railway was furnished and erected by the Pennsylvania Steel Co.

New York Engineer Positions Standardized

The Senate Committee on Civil Service of the New York legislature (Clinton T. Horton, Chairman) has organized a special staff which is studying all the civil-service positions of the state and preparing specifications which show standard titles, standard salary rates, work requirements, qualifications for appointment and promotion, etc. The engineering positions constitute a group in the professional and scientific service, and tentative specifications have been prepared; these are reprinted in the appended paragraphs, with the approval of the senate committee, which desires constructive criticisms from the profession. (Correspondence should be addressed to Room 225, Capitol, Albany, N. Y.)

GRADE I: ENGINEERING ASSISTANT

Duties—Under instruction and supervision, elementary or apprentice work in field or office in one or more of the specialized engineering branches. Examples: Holding a rod; making measurements with a steel tape; tracing simple designs; tabulating estimates; inspecting minor details.

Qualifications—Persons holding these positions shall have such qualifications as may be required by the State Civil Service Commission.

Compensation—The range of annual compensation of this grade for full time service is from $720 to $1,080 inclusive, with standard salary rates as follows: $720, $780, $840, $900, $960, $1,020, $1,080.

Regulation Governing Initial Rate—Such training in civil, mechanical, electrical, sanitary or other engineering branches as is evidenced by a degree granted on the completion of a standard course of instruction in an engineering school of recognized standing will be accepted as the equivalent of the first three years of service in this grade.

Three years of practical experience in engineering apprentice work in addition to the minimum requirements of the State Civil Service Commission for appointment at the initial rate will be accepted as the equivalent of three years of service within this grade.

Where allowance is made for technical training or practical experience under this special regulation, the State Civil Service Commission will add such tests to the competitive examination for this grade as are necessary to determine the compliance with the prescribed training or experience standards.

Temporary Employment—Standard salary rates for temporary service in this grade shall be designated under the rules of the State Civil Service Commission on the basis of existing conditions, provided that the third rate, $900, shall be the maximum for any such employment.

GRADE II: JUNIOR ASSISTANT ENGINEER, JUNIOR ASSISTANT CIVIL, ELECTRICAL, MECHANICAL OR SANITARY ENGINEER

Duties—To assume responsibility for the execution of definite instructions in a minor section or division of an engineering project in the field or office. Examples: Running a transit or level; preparing or examining plans and designs, under supervision, for concrete construction, bridges, mechanical and electrical appliances; inspecting engineering work and materials; preparing general working drawings for engineering projects; making computations and compiling data for reports and cost records; directing the operation of electrically driven machinery.

Qualifications—Persons holding these positions shall have (1) as a basis for promotion: (a) The minimum qualifications prescribed for Grade I; (b) not less than four years of service in Grade I; or (c) such training in civil, mechanical, electrical, sanitary or other engineering branches as is evidenced by a degree granted on the completion of a standard course of instruction in an engineering school of recog-

nized standing, and in addition not less than two years of service in Grade I; (d) such additional qualifications as may be required by the State Civil Service Commission; (2) as a basis for original appointment: (a) Not less than four years of experience in the particular branch of engineering work covered in the position to be filled; (b) such additional qualifications as may be required by the State Civil Service Commission.

Compensation—The range of annual compensation of this grade for full-time service is from $1,200 to $1,800, inclusive, with standard salary rates as follows: $1,200, $1,320, $1,440, $1,560, $1,680, $1,800.

Temporary Employment—Standard salary rates for temporary service in this grade shall be designated under the rules of the State Civil Service Commission on the basis of existing conditions, provided that the third rate, $1,440, shall be the maximum for any such employment.

GRADE III: ASSISTANT ENGINEER, ASSISTANT CIVIL, ELECTRICAL, MECHANICAL OR SANITARY ENGINEER

Duties—To assume responsibility for the making of surveys or the preparation of plans, designs, specifications and contracts for a minor section of a large engineering project or the major section of a small engineering project; to supervise or inspect construction work of such project; to operate a completed section of such project; and to make investigations of and reports upon engineering projects, as a basis for executive action. Examples: Directing a field party on surveys, construction or repair work; supervising a squad or division in designing and preparing plans, estimates and specifications; assuming responsibility for the construction, installation or operation of a minor division under a pumping, watershed, power production, purification or sewage-disposal project; or the installation of a heating, lighting, plumbing or electrical plant; preparation of highway layout and grades; making engineering investigations and reports relating to building encroachments, sewer construction, sewage disposal, traffic conditions, highway-opening proceedings, applications for franchises.

Qualifications—Persons holding these positions shall have (1) as a basis for promotion: (a) The minimum qualifications prescribed for Grade II; (b) not less than three years of service in Grade II; (c) such additional qualifications as may be required by the State Civil Service Commission; (2) as a basis for original appointment: (a) Not less than seven years of experience in the particular branch of engineering work covered in the position to be filled; (b) such additional qualifications as may be required by the State Civil Service Commission.

Compensation—The range of annual compensation of this grade for full-time service is from $1,980 to $2,580 inclusive, with standard salary rates as follows: $1,980, $2,160, $2,340, $2,580.

Regulation Governing Salary—The entrance and other salary rates of positions classified within this grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

GRADE IV: SENIOR ASSISTANT ENGINEER, SENIOR ASSISTANT CIVIL, ELECTRICAL, MECHANICAL OR SANITARY ENGINEER

Duties—To supervise and assume complete responsibility for the work of a main division of a small organization or a large subdivision of one of the main divisions of a large organization, involving surveying, designing or construction; to maintain or operate a major section of a large engineering project; and to make independent investigations of and reports upon engineering projects, as a basis for executive action. Examples: Supervising a main division of a large bureau of design; supervising the construction, installation or operation of a major division of a large power production, purification or disposal plant; supervising the installation of a major division of a heating, lighting, plumbing or electrical plant; supervising the construction, operation, maintenance or repair of a major division of sewers, highways, bridges, aqueducts, reservoirs, tunnels or public buildings; supervising engineering investigations, inspections, estimates and reports for municipal improvements; taking charge of a section of the work on the Barge Canal, such as assuming charge of a residency of the State Engineer's office.

Qualifications—Persons holding these positions shall have (1) as a basis for promotion: (a) The minimum qualifications prescribed for Grade III; (b) not less than three years of service in Grade III; (c) such additional qualifications as may be required by the State Civil Service Commission; (2) as a basis for original appointment: (a) Not less than 10 years of experience in engineering work, at least half of which must have been in the particular branch of engineering work covered in the position to be filled and three years of which must have been in a minor executive capacity; (b) such additional qualifications as may be required by the State Civil Service Commission.

Compensation—The range of annual compensation of this grade for full-time service is from $2,820 to $3,600 inclusive, with standard salary rates as follows: $2,820, $3,060, $3,300, $3,600.

Regulation Governing Salary—The entrance and other salary rates of positions classified within this grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

GRADE V: ENGINEER, CIVIL, ELECTRICAL, MECHANICAL OR SANITARY ENGINEER

Duties—Require a high degree of executive ability and specialized engineering technique and involve the making of decisions in administrative and engineering matters, subject to statutory limitations only; to supervise and assume entire responsibility for the work of a small independent organization; to supervise and assume complete responsibility for the work of a primary division of a large organization; and to make independent investigations of and reports upon engineering projects, as a basis for executive action. Examples: Acting as chief engineer of a bureau of a large department; acting as a division engineer of one of the three divisions in the State Engineer's office or as division engineer in the Department of Highways.

Qualifications—Persons holding these positions shall have (1) as a basis for promotion: (a) The minimum qualifications prescribed for Grade IV; (b) not less than three years of service in Grade IV; (c) such additional qualifications as may be required by the State Civil Service Commission; (2) as a basis for original appointment: (a) Not less than 13 years of experience in engineering work, at least half of which must have been in the particular branch of engineering work covered in the position to be filled and four years of which must have been in a major executive capacity; (b) such additional qualifications as may be required by the State Civil Service Commission.

Compensation—The range of annual compensation of this grade for full-time service is from $3,900 to $5,400 inclusive, with standard salary rates as follows: $3,900, $4,200, $4,500, $4,800, $5,100, $5,400.

Regulation Governing Salary—The entrance and other salary rates of positions classified within this grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

GRADE VI: CHIEF ENGINEER, CONSULTING ENGINEER OR SUPERVISING ENGINEER

Duties—Require the highest order of executive or advisory ability and involve the making of final decisions in administrative and engineering matters, subject to statutory limitations only; to supervise and assume entire responsibility for all the engineering work of a large independent organization; or to supervise the construction of engineering projects or works of great magnitude and complexity; or to give independent, expert or critical engineering advice of the highest order, as a basis for executive action relative to work of this scope. Examples: Acting as State Engineer; acting as consulting engineer to a state department; acting as engineer of a division of subway construction.

Qualifications—Persons holding these positions shall have (1) as a basis for promotion: (a) The minimum qualifications prescribed for Grade V; (b) not less than five years of service in Grade V; (c) such additional qualifications as may be required by the State Civil Service Commission or the appointing agency; (2) as a basis for original appointment: Chief Engineer, (a) not less than 18 years of experience in engineering work, at least half of which must have been in the particular branch of engineering work covered in the position to be filled and five years of which must have been in a major executive capacity; (b) such additional qualifications as may be required by the State Civil Service Commission; Consulting Engineer or Supervising Engineer, (a) not less than 18 years of experience in the particular branch of engineering work covered in the position to be filled; (b) such additional qualifications as may be required by the State Civil Service Commission.

Compensation—The annual compensation of this grade for full-time service, with standard salary rates, is as follows: $6,000 and up.

Regulation Governing Salary—The entrance and other salary rates of positions classified within this grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

New Railroad Coaling Pier To Have Belt Conveyors

The new coal-shipping pier at the Curtis Bay terminal of the Baltimore & Ohio R.R., at Baltimore, Md., will have the unusual feature of belt conveyors to carry the coal along the pier and will have transverse belt conveyors (on travelers) to deliver it to ships and barges moored at the pier. Car dumpers are used, but they are on the shore and serve to feed the conveyors. The general layout of the plant is shown in Figs. 1 and 2.

The pier will be 700 ft. long and 115 ft. wide, with its deck about 8 ft. above the water level. The two railway tracks serving the pier are diagonal to it. Each track leads to a car-dumping machine, which elevates and overturns the coal cars, dumping their contents into an elevated bin of 120 tons capacity. The two machines can handle 80 cars per hour (50-ton cars). Each bin has spouts discharging to three 60-in. belt conveyors. Feeder belts take the direct discharge of the spouts, thus giving a regular flow of coal to the main conveyors and relieving the latter of the heavy wear.

Four of the six conveyors extend along the pier and serve four lateral conveyors in towers, which travel along the pier and are spotted at the hatchways of the vessels. Each main conveyor has its own tower and is led up to it on an inclined truss. The other two 60-in. conveyors are mounted on inclined swiveling cantilever trusses and deliver coal from the dumping-machine hoppers to two storage bins of 1,000 tons capacity each, to two 1,500-ton trimming bins. From these it is led to the pier conveyors as required. Provision is made for two additional 1,000-ton trimming bins in the future.

Besides the conveyors already mentioned there will be two 48-in. belt conveyors extending the full length of the pier and each having a portable tower with lateral conveyor. They will be fed from the storage and trimming bins and will supply the coal required for trimming the cargo in the hold. They will serve also to deliver coal to the ships' bunkers while the other conveyors are delivering coal into the holds for cargo. The belt conveyors will run at 250 to 500 ft. per hr., giving a carrying capacity of 3,000 to 6,000 tons per hr.

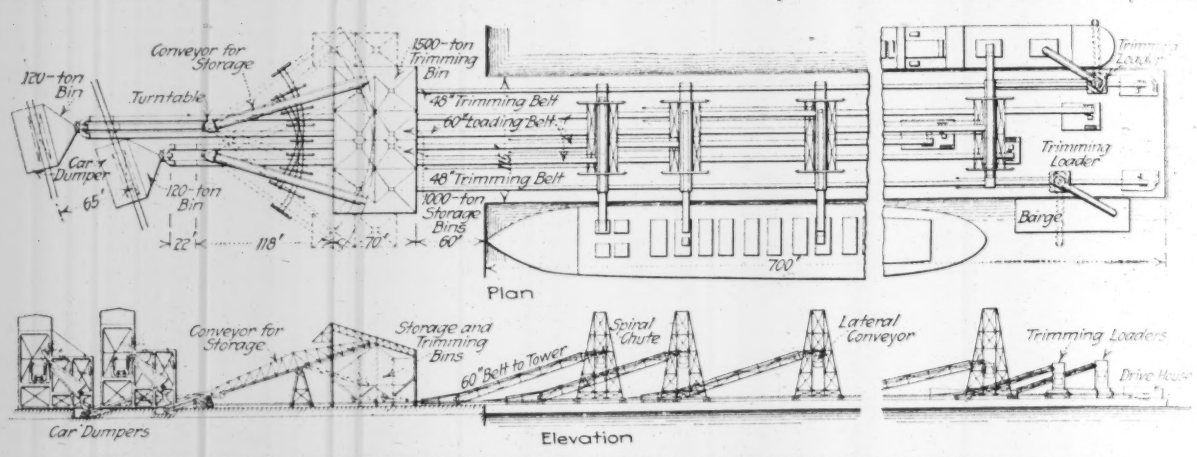


FIG. 1. PLAN AND SIDE ELEVATION OF COAL-SHIPPING PLANT WITH BELT CONVEYORS FOR THE BALTIMORE & OHIO R.R., BALTIMORE, MD.

The coaling towers are steel frames carrying a 118-ft. transverse truss frame, which has a vertical travel of 27 ft., being moved by power-operated screws. Within it is another frame, which carries the lateral conveyor and which can be extended about 35 ft. beyond either side of the pier. The coal discharged from the main pier conveyor is delivered to the lateral conveyor through a spiral chute, in order to minimize breakage of the coal.

At each end of the conveyor frame is a "lowerator," or flight conveyor, contained in a vertical tube, so that the coal is delivered into the hold with little or no drop.

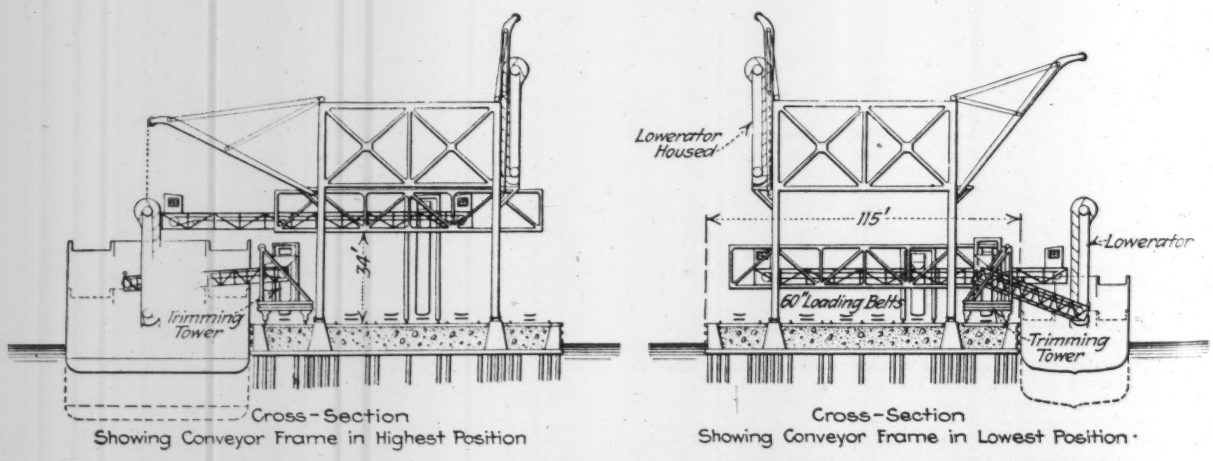


FIG. 2. SECTIONAL ELEVATIONS OF TRAVELING CONVEYOR TOWERS ON COAL SHIPPING PIER

but flows out over the pile of coal. The lowerator has a speed of 90 ft. per min. It is raised gradually to keep its lower end level with the top of the coal pile as the hold is filled. In this way, breakage of coal in loading will be reduced to a minimum. The towers of the two trimming conveyors have no lowerators. The conveyor boom of the tower is carried by a revolving frame, or turntable.

This coal pier will cost about $1,500,000 and will have a shipping capacity of about 10,000,000 tons per yr. It was designed under the direction of F. L. Stuart, Chief Engineer of the Baltimore & Ohio R.R.

New Water-Meter Policy for New York City

The hand-and-foot-bound water-meter policy of New York City will be radically changed if the New York legislature enacts a bill drawn and introduced in behalf of the Department of Water-Supply, Gas and Electricity of New York City and if, as is to be presumed, the Board of Aldermen coöperates with the commissioner of water-supply in carrying out the intent of the bill.

As matters now stand, the Department of Water-Supply is in pitifully helpless condition as regards not only the installation of water meters, but also the fixing of water rates, both for metered and unmetered services. At present the commissioner can install meters in business places only. Even those meters are under private ownership; and when they are taken out for repair, the water flows unmetered sometimes for several months. Meters cannot be installed in private residences, not even in the large apartment houses, without the consent of the Board of Aldermen. Moreover, the corporation counsel has given an opinion that, if the board were to consent, it would have to be a case of metering all or no residences or apartment houses at one and the same time. To make the case still worse, private-property owners have no right to demand the installation of the water meter.

To add still further to the anomalous situation, there are in existence on residential premises about 13,000 meters, installed by private companies the property of which has been taken over by the city. The use of these meters can be discontinued by the property owners at any time. Moreover, the city has under consideration the taking over of private water companies supplying some 100,000 inhabitants of the city. If this were done, the large number of meters on the services owned by these companies would also be subject to discontinuance.

Present Charges Antiquated

The immense residential population of Greater New York is, with the anomalous exceptions already noted, charged with water on a plan that is unusual and antiquated—that is, a combination of a frontage and a fixture charge. It needs no argument to show that this is an unjust and unreasonable, as well as wholly uncertain, way of charging for water.

In a printed memorandum prepared by the Department of Water-Supply, accompanying its bill now before the legislature, it is stated that, when the department takes over the great Catskill water-supply works with their heavy capital charges, it "will face a deficit for a number of years unless revenues can be increased." The memorandum also mentions the fact that the city now gets about half its revenue from the sale of water by meter measurement, although the water "so sold is less than 27% of the total amount of water consumed, lost and wasted." The large modern apartment houses in most cases are paying on the frontage and fixture basis only 30 to 40% of what they would pay at regular meter rates.

Details of New Scheme

Only part of the provisions of the bill before the legislature have been brought out by what has preceded. The whole effect of the bill is shown by the following quotation, which summarizes the principal changes that the bill would bring about. These are:

1. The discretion of the commissioner to install meters is extended from business places only to all places connected with the public water-supply.
2. The department, with the approval of the Board of Aldermen, may assume the expense of furnishing, installing and maintaining meters, thus changing the system from private ownership to city ownership of meters.
3. The department, with the approval of the Board of Aldermen, is authorized to acquire meters now owned by the property owners and to assume the expense of keeping them in repair.
4. The right to demand the installation of a meter is extended to every property owner connected with the public water-supply.
5. The city is authorized to establish annual service charges and minimum charges in connection with the schedule of meter rates.
6. The department is authorized to apply the revenue from service charges to the financing of the meter system.
7. The method of estimating the amount of water used while a meter is out of repair is made more elastic.
8. Certain minor changes are made which are incidental to the smooth administration of the department under the new conditions.

If the bill is enacted, the Department of Water-Supply purposes to submit a new schedule of metered rates to the Board of Aldermen, also a plan for a meter setting and repair division and a plan for acquiring about 100,000 water meters now in private ownership. An additional proposal—in some respects the most interesting of all—is thus expressed:

> The department will submit to the Board of Aldermen for approval a standard design and specifications for a New York City meter to be purchased from time to time under competitive bidding at a price not to exceed a maximum approved by the board.

That the department really means business is intimated by a statement to the effect that "the complete metering of the city under proper conditions will probably require not less than five years."

William Williams is commissioner and Delos F. Wilcox is deputy commissioner of the Department of Water-Supply, Gas and Electricity of New York City.

Ontario Power—The following official statement regarding the policy of the Ontario government in connection with obtaining further supplies of electric power from Niagara Falls has been published: The Government of the Province of Ontario has been considering the question of providing additional electric power from Niagara and has had placed before it the results of investigations by the engineers of the Hydro-electric Commission. It appears from these reports that today the municipalities in western Ontario are using all the electric energy which was contracted for by the commission and that within the next five years an additional 100,000 hp. will be required. The Government has determined to meet the situation and at the forthcoming session of the House will submit legislation authorizing the supply of such additional power as may be required. Many questions, legal and financial, must first receive careful consideration; but the policy of this Government is to meet the wishes of the people by placing itself in a position to supply electrical power just so soon as financial conditions warrant it.

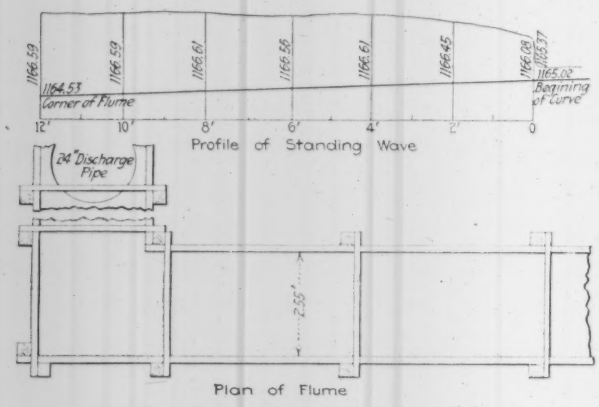
Field and Office

Standing-Wave Experiment

By Robert E. Horton*

In view of the scarcity of data regarding the form and height of standing waves, other than very small experimental waves such as were investigated by Bidone, the accompanying sketch plan and profile may be of interest.

The plan represents the downstream portion of an open rectangular timber flume which was constructed to carry



STANDING WAVE IN FLUME, HINCKLEY, N. Y.

temporarily a large municipal water-supply over the site of a dam during construction. There was a right-angled turn in the flume at the lower end, and the water flowed out through a submerged 24-in. cast-iron pipe, the quantity of flow being measured by a standard weir in a concrete chamber into which the cast-iron pipe discharged a short distance downstream. The slope of the bottom of the flume was 1 in 24, and the water surface was parallel with the bottom slope for a considerable distance upstream from the head of the standing wave. The total quantity of water flowing in the flume was 10.78 cu.ft. per sec., and the depth of water above the head of the standing wave was 0.35 ft. The width of the flume inside was 2.55 ft.; area of flowing section, 0.892 sq.ft.; mean velocity, 12.08 ft. per sec.; velocity head, 2.27 ft.

The standing wave rose abruptly and almost vertically 0.71 ft. It then rose gradually, with a surface convex upward, 0.53 ft. in a distance of 4 ft., making a total rise of 1.24 ft. and a total depth above the channel level at the head of the wave of 1.59 ft. This corresponds to d_2 in the formula for height of standing wave as usually given, which is

$$d_2 = 2\sqrt{d_1 \frac{v_1^2}{2g}}$$

The depth of water and the velocity respectively above the upstream end of the standing wave are represented by d_1 and v_1. By this formula d_2 should have been 1.78 ft., showing that in this case the standing wave rose to about 90% of the theoretical height.

The experimental data were obtained under the writer's direction by the late A. B. Tracey.

*Consulting Hydraulic Engineer, Albany, N. Y.

Cranes Handle Drop-Bottom Cars for Filling

The enlargement of Grant Park, Chicago, by filling in along the lake front is being carried on in an unusual way. The material is delivered in drop-bottom boxes on small flat-cars, and these boxes are handled and dumped by cranes. The work is at the south end of the park and includes the site of the new Field Museum, described

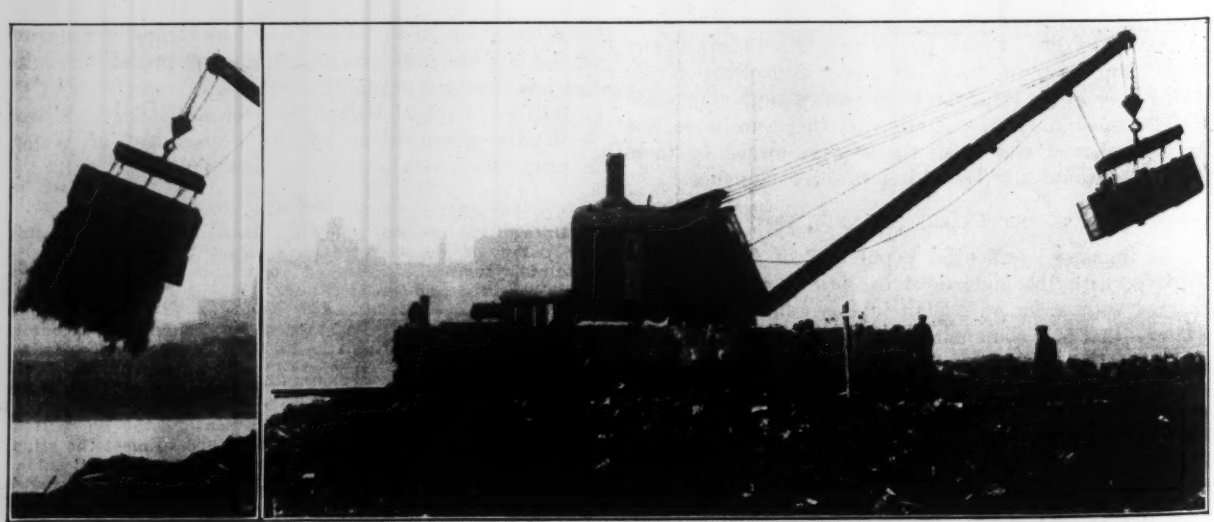


FIG. 1. LOCOMOTIVE CRANE HANDLING 5-TON CARS FOR FILLING AT GRANT PARK, CHICAGO

The cars are of 24-in. gage, and come from the underground railway. The small view at the left shows the car body being dumped. The locomotive is a gasoline machine

in *Engineering News*, Jan. 6, 1915. The filling consists of ashes, rubbish from wrecked buildings and material from excavations. The W. J. Newman Co. has the contract for the work.

At one point the material is delivered by the narrow-gage underground electric-railway system of the Chicago Tunnel Co., one of the tunnels being extended under the Illinois Central R.R. to a shaft at the west side of the park. The shaft is about 50 ft. deep and has an elevator large enough to handle the tunnel cars. The railway is of 24-in. gage, and double-truck flat-cars with removable wooden bodies are used to handle the material. The bottom of the box, or body, is hinged at one side and held in place by a latch. The cars are handled in the tunnels by electric locomotives using trolley wires.

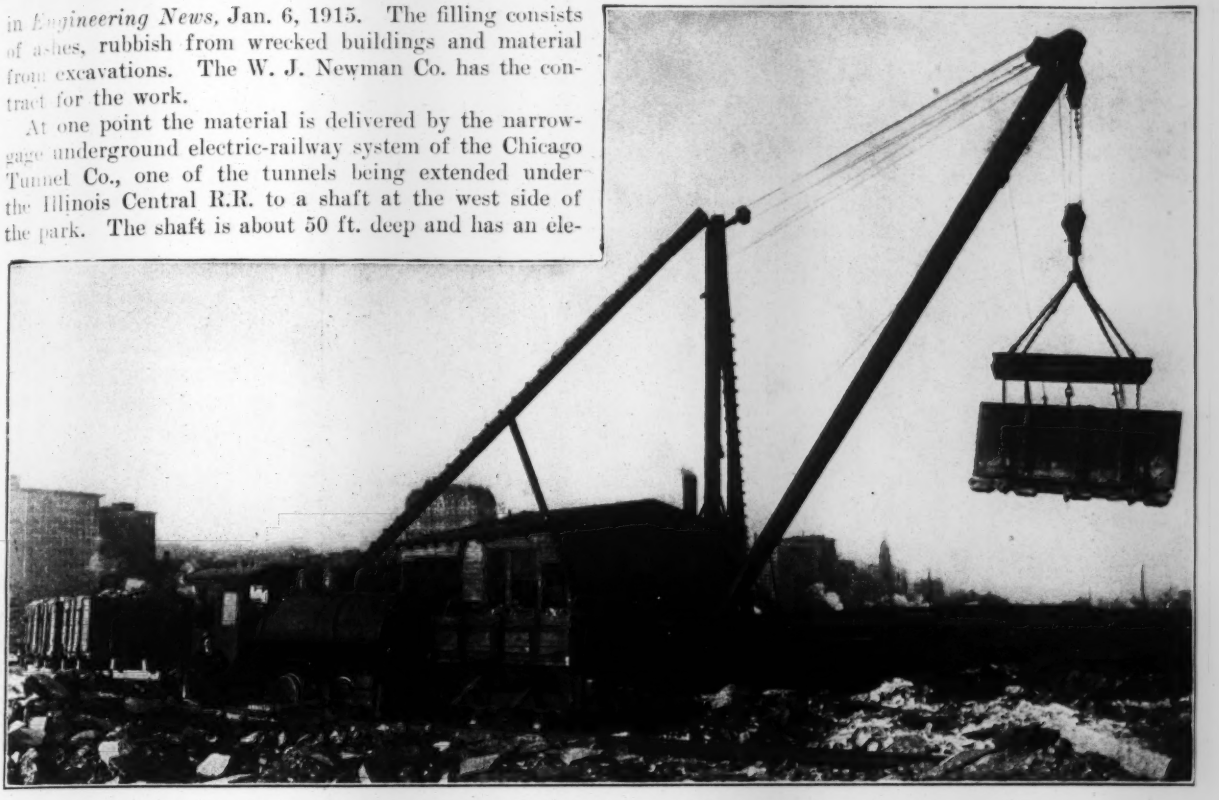


FIG. 2. DERRICK HANDLING 7-TON CARS FOR FILLING AT GRANT PARK, CHICAGO
The cars are of 36-in. gage, hauled by a steam locomotive

At the shaft house the cars are assembled in trains and hauled by 7-ton Baldwin gasoline locomotives to the dump. A 60-ton Bay City locomotive crane takes the body from the car and swings it into position. The latch is released, allowing the bottom to drop and the contents to escape. The crane then returns the empty body to the car. This dumping plant is shown in Fig. 1. The weight of the loaded car body is about 5 tons.

The locomotive crane travels on a standard-gage track. It has a 45-ft. boom and a 25-hp. steam engine, and its hoisting capacity is 15 tons at a reach of 10 ft. The hoisting hook carries a rectangular frame having chains attached to the car body. A cord leading from the cab and over a pulley on the boom is hooked to the latch, so that the engineman can trip it and dump the load. At this plant about 200 cars are emptied daily.

At another part of the work, dirt and rubbish from excavations and old buildings are delivered by contractors in wagons. To avoid a nuisance and to give better control of the filling, the wagons dump their contents at an elevated platform in a covered building, or disposal station, at the side of the park. From this upper floor the material is shot through chutes into cars standing on a track at the ground level. These cars travel on a track of 36-in. gage and have removable bodies 10x4½ ft., 4 ft. deep. They contain about 6½ cu.yd. and weigh about 7 tons loaded.

Trains of these cars are taken by a 20-ton steam locomotive to a large A-frame derrick that handles, dumps and replaces the car bodies in the same way as the locomotive crane already described. This dumping plant is shown in Fig. 2. The derrick has a 65-ft. boom and a 35-hp. steam engine. It weighs 60 tons, has a hoisting capacity of 20 tons and is shifted on rollers as the work progresses. It was built by the W. J. Newman Co. and handles about 100 cars daily.

Novel Construction Features of Cincinnati Concrete Bridge

By Edgar K. Ruth*

In the design and operation of his construction plant, the contractor for the new reinforced-concrete viaduct that carries Park Ave. over Kemper Lane into Eden Park, in Cincinnati, Ohio, introduced several methods tending to reduce costs or produce better results.

The first was the advantageous use of a portion of the old steel viaduct and its piers and abutments. By using the end of the viaduct as a platform for charging the mixer a considerable saving of plant cost was made. This old viaduct, built over 50 years ago, was a light steel structure, consisting of six deck Pratt-truss spans varying from 50 to 65 ft. in length, resting on wrought-iron Phœnix columns, masonry piers and masonry abutments. The roadway was 18 ft. wide, with 7-ft. sidewalks on each side, the viaduct having an overall width of 32 ft.

The floor system consisted of 3x12-in. oak planking laid crosswise on 4x16-in. oak stringers, which were sup-

*Assistant Engineer, Engineering Department, Cincinnati, Ohio.

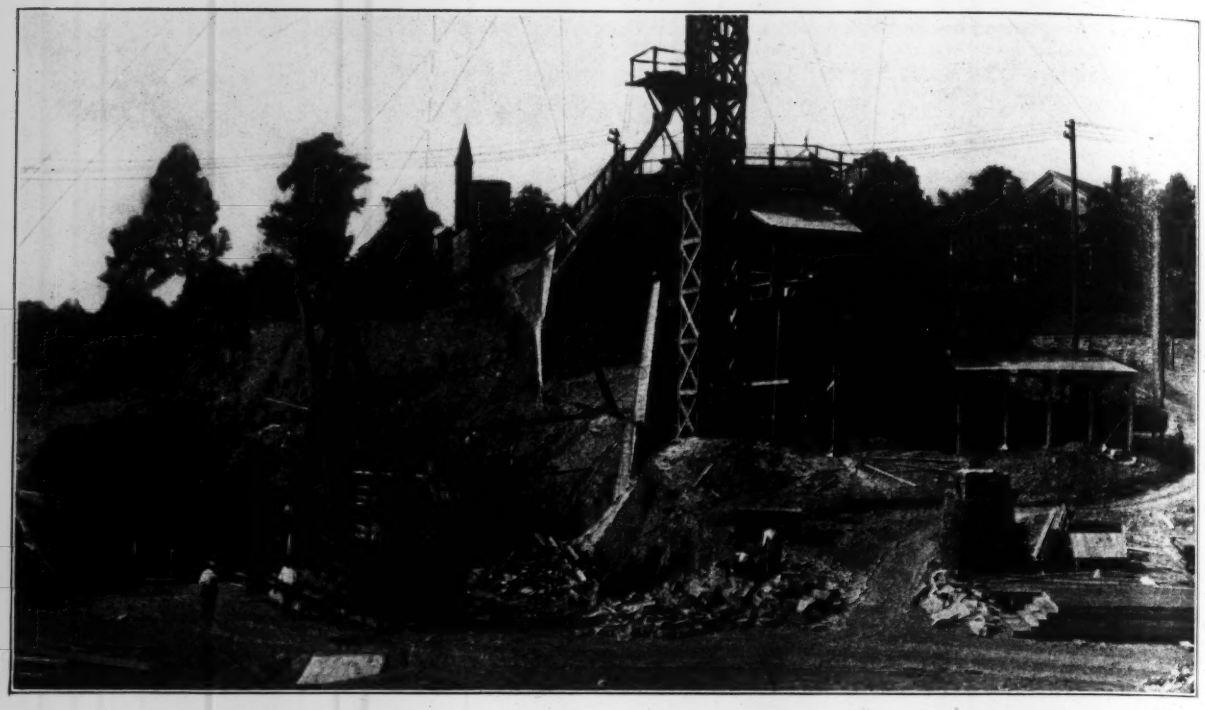


FIG. 1. CONCRETING PLANT FOR NEW PARK AVE. VIADUCT, CINCINNATI, UNDER PART OF OLD VIADUCT

ported on 10½-in. iron crossbeams spaced 8 ft. c. to c. The two trusses forming each span were spaced 17 ft. 6 in. c. to c. and were of unique design in that their vertical compression members were wrought-iron posts and the lower-chord tension members consisted of wrought-iron links, joined at panel points around the cast-iron base blocks of the vertical posts. All wrought-iron links were found to be in an excellent state of preservation, but the struts and columns, though also of wrought iron, were deeply pitted and covered with scaly rust.

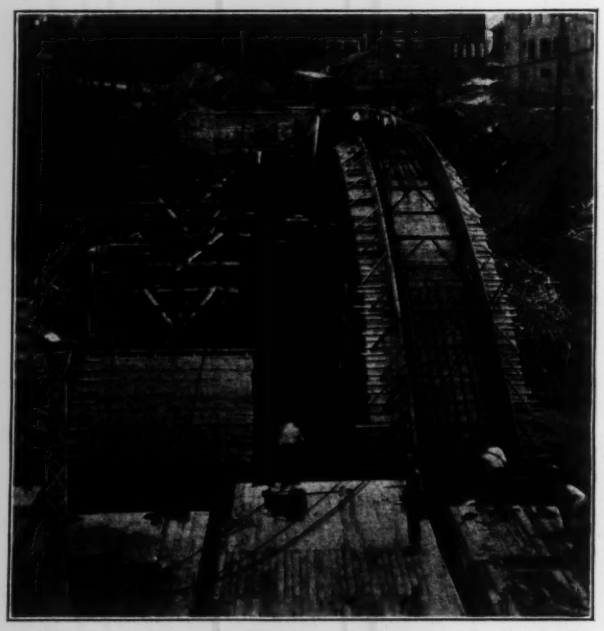


FIG. 2. PARK AVE. VIADUCT UNDER CONSTRUCTION, SHOWING CROSS-FRAMES TO HOLD REINFORCING

The new viaduct is a reinforced-concrete structure, consisting of a central three-ribbed arch of 180-ft. clear span and 31-ft. rise, over Kemper Lane, and symmetrical end approaches made up of 25-ft. girder spans, the outside girders being arched. The total length between end abutments is 360 ft., and the total width is 65 ft., there being a 40-ft. roadway and two 12-ft. 6-in. sidewalks.

It was necessary at the start of the work to wreck the old viaduct completely, except the southerly 55-ft. span, which rested at one end on two masonry piers extending 20 ft. above the ground and at the other end on a masonry abutment of U-type. It happened fortunately that this span and its piers just cleared the outside line of the new structure, so the contractor left it in place and built his concrete mixing and distributing plant around it (Fig. 1).

Stone and sand bins of 100 and 50 cu.yd. capacity respectively were constructed between the trusses, underneath an opening in the floor planking. The bottoms of the bins were sloped steeply, to deliver the materials directly to the mixer by gravity. The stone and sand were delivered to the bins from end-dump motor trucks of 5 tons' capacity. Cement from the storehouse adjacent to the bridge was wheeled as needed out to the end of the bridge and chuted to the charging platform below, where was the upper hopper of the mixer.

The mixer is a Hains automatic gravity mixer of ⅓ cu.yd. capacity. It has four conical sheet-steel hoppers placed in series one above the other. The top of the upper hopper is flush with the charging platform, about 18 ft. above the ground and about 15 ft. below the floor of the bridge. A simple arrangement of levers requires but three men to charge the upper hopper with the proper quantities of cement, sand, stone and water and to drop the charge from hopper to hopper at the proper intervals, thence directly into the hoist bucket at the base of the

tower. The tower is 140 ft. high and delivers the concrete through chutes to an extreme distance of 300 ft.

Fig. 2 shows centering in place for two of the three ribs of the 180-ft. arch. Part of the reinforcing steel, consisting of 1⅝-in. round bars, is in place on the outer line of centers. These bars are shown held accurately in alignment and elevation by means of rectangular frames of steel angles. The upper legs of the horizontal angles are notched to receive the bars and hold them to the proper spacing.

Fig. 3 shows the two ribs poured and the centering removed. The centers shown were released from under the middle rib by driving out the oak wedges and were then pulled bodily into position for the third rib. This work was accomplished by use of a derrick and hoist, the different bents being pulled forward a small distance at a time. Little damage to the centering resulted; and the cost of the operation was considerably less than it would have been, had the centering been wrecked and reërected in its new position, as was contemplated in the original plan.

The entire improvement, when completed, will cost about $130,000 and includes in addition to the viaduct considerable grading and street work. The contractor is D. P. Foley. The plant was designed by his engineer and superintendent, P. Beall. The viaduct was designed and its construction is being supervised by the Division of Structures, City Engineering Department, of which F. S. Krug is Chief Engineer; F. L. Raschig, Principal Assistant Engineer in Charge of Structures; Paul Laur, Assistant Engineer on Construction; and R. J. Coffin, Resident Engineer. The writer had charge of the design and preparation of plans and specifications.

Floating Concrete Plant at Dam No. 39, Ohio River

By Fred C. Todd*

The floating concreting plant shown in the photographs and sketch on the next page was used with great success during the past season at lock and dam No. 39, on the Ohio River near Florence, Ind. The plant is built on a specially constructed hull 80x36 ft. in plan. Located in the middle and 24 ft. from the front end, there is a 6x6-ft. well extending to the bottom of the barge. A 90-ft. steel tower is erected over this well and is supported by a heavy timber A-frame and numerous guy wires placed sufficiently forward so as not to interfere with the operation of a clamshell bucket. On the front end of the barge there are two boilers—a 4-in. horizontal pump and a two-drum hoisting engine. Ten feet behind the tower are two 1-yd. mixers set 3 ft. above the deck, each run by an independent engine.

Over the mixers there are two sets (one for stand-by service) of sand and gravel hoppers, each of 18 yd. capacity. These hoppers are placed near the center line of the barge (fore and aft), so that loading of hoppers does not cause the barge to list. The hoppers are suspended from the top bracing by tie-rods, there being no supports to interfere with the workmen. The cement platform is directly behind the hoppers. The barge is equipped with spuds.

The cable for suspending the chutes runs from the engine up the back of the tower and through a cast-iron funnel at the top of the A-frame and is attached to a deadman on the bank. Deadmen are placed 100 ft.

*Inspector, 3920 Hazel Ave., Norwood, Ohio.

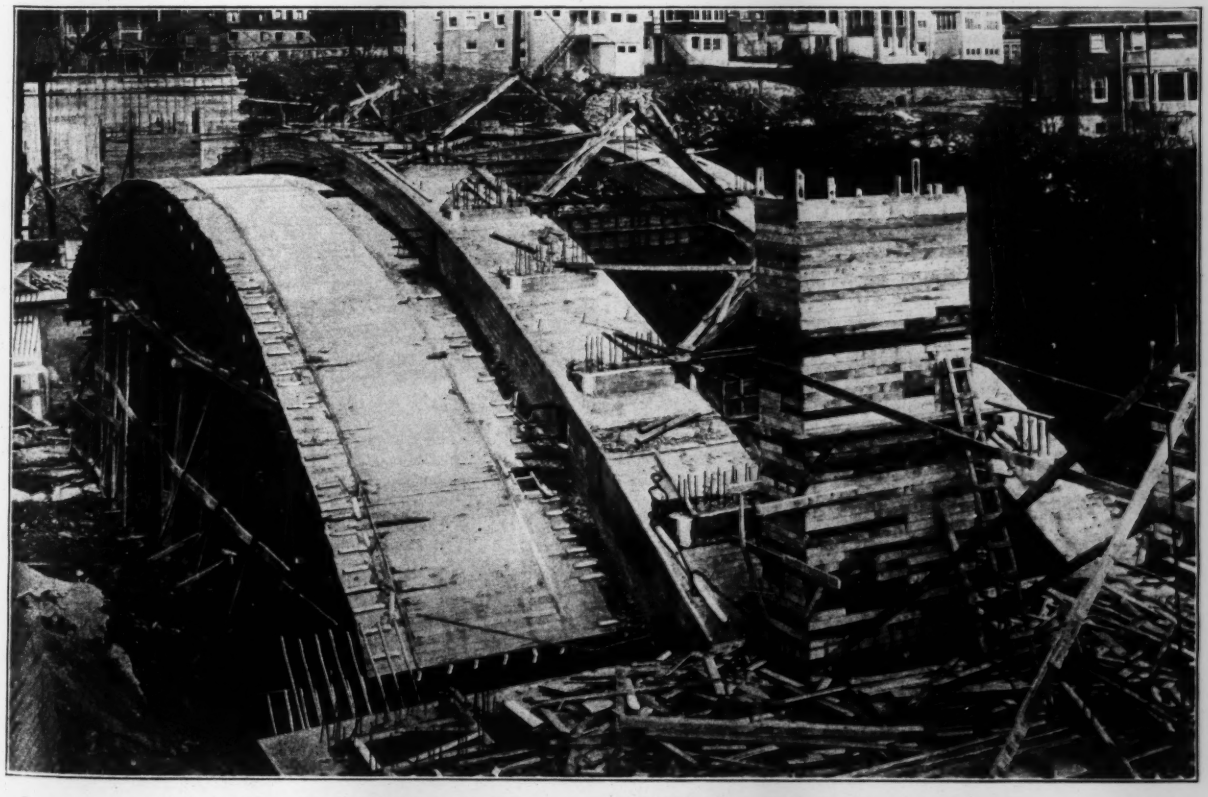


FIG. 3. TWO ARCH RIBS COMPLETE AND CENTERING BEING MOVED TO THIRD RIB

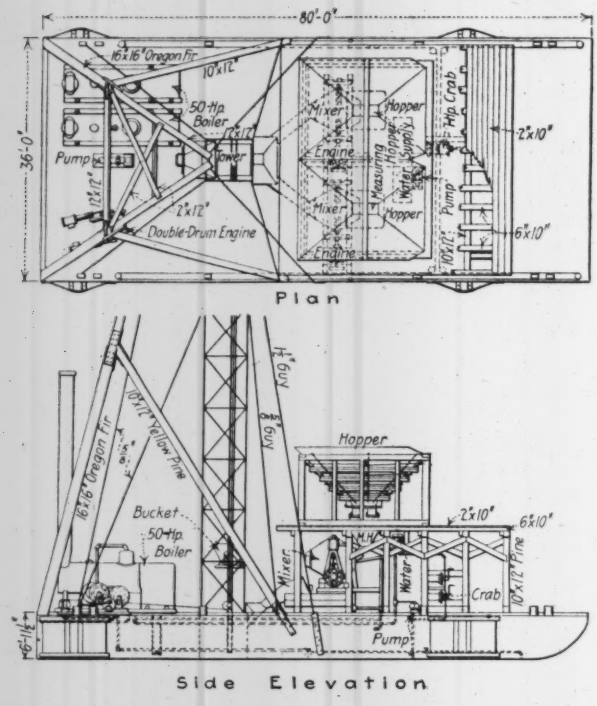


FIG. 1. DESIGN OF THE FLOATING CONCRETING PLANT

apart, so that by the use of an auxiliary cable attached to the main cable and to the deadman next to the one to which the main cable is attached any intermediate position of the chute can be secured by adjusting the length of the auxiliary cable. For this purpose a 1¼-in. block-and-fall is fastened to the main cable and the deadman to which the auxiliary cable is to be attached. A team of horses then draws up on the block-and-fall until the chutes are in the required position, when the auxiliary cable is fastened to the deadman and the block-and-fall taken off.

The novel feature of this plant is that the main cable supporting the chutes is attached to one drum of the hoisting engine. This arrangement facilitates quick moving of the plant. When a move is to be made, the cable is slacked off, lowering the chutes until they just clear everything that retains the tension of the cable.

The derrick boat (having spuds) is placed several hundred feet back of the tower boat, which it pulls out into the river by a line, clearing the coffer-dam. The barge (chutes and all) can then be easily moved sidewise by means of a winch line. As the plant is being moved, the main cable is slacked or hoisted to give proper sag to the cable, as required. The outfit can be shifted and concreting started, in from 1¼ to 3 hr., depending upon the distance covered.

The maximum distance of pouring has been about 325 ft., which permits a slope of the chute of 1:3. The average output of the plant is 45 cu.yd. per hr.; but it has attained as high as 70 yd., when the work had to be rushed.

Sand and gravel are delivered by water. A derrick boat with 70-ft. boom and 2-yd. clamshell bucket is placed directly behind the tower boat, with the sand barge on one side of the plant and the gravel barge on the other. The barges are moved by a steam crab on the tower boat, while they are being unloaded. This arrangement permits operation of the derrick boat with little necessity for changing the height of the boom. Cement is loaded at the storehouse directly on the racks placed on a flat-car. Each car holds seven racks, 80 bags of cement on each rack. The loaded cars are run down an incline to the water's edge and onto a transfer barge. The barge, with two cars, is towed and placed alongside the sand barge. Each rack is picked up by the derrick boat as needed and placed directly back of the bins. There is no railroad connection at dam 39, and rail shipments of material are received by the transfer boat.

Bids were requested for lock and dam No. 39 on Nov. 11, 1913. As no bids were received, the Government itself undertook the project. Work was started in June,

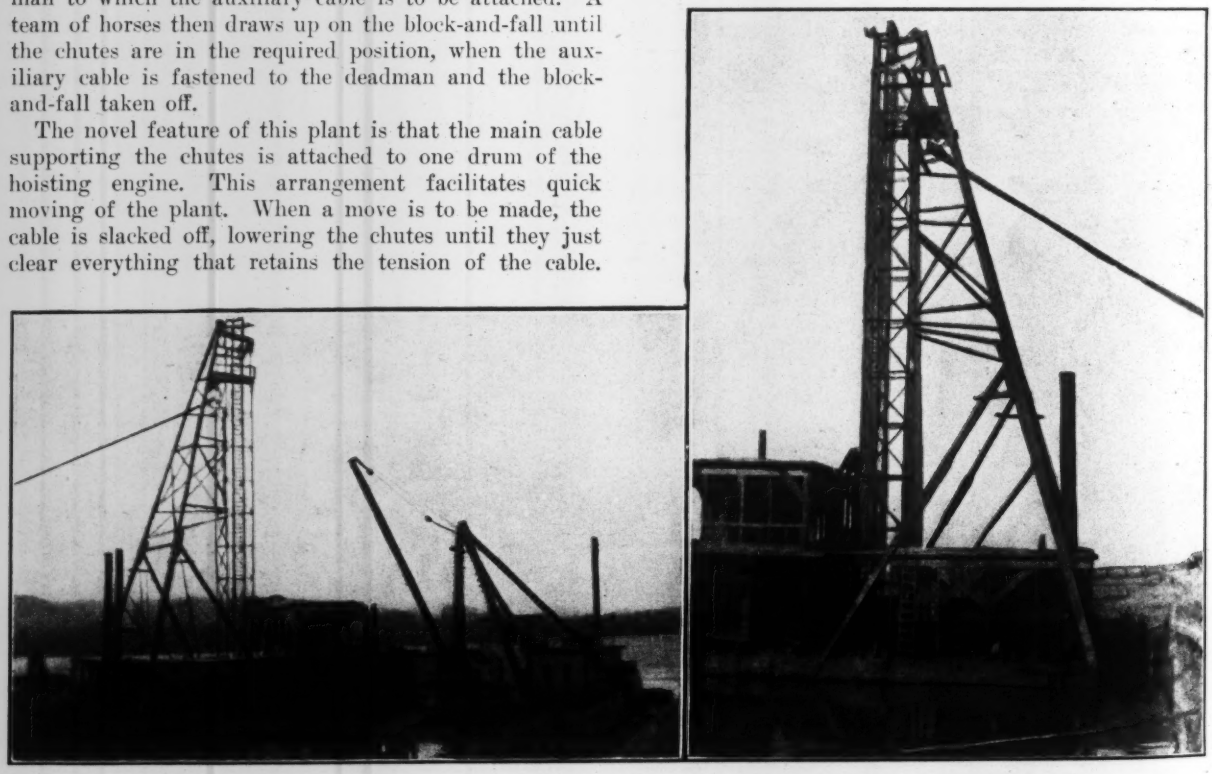
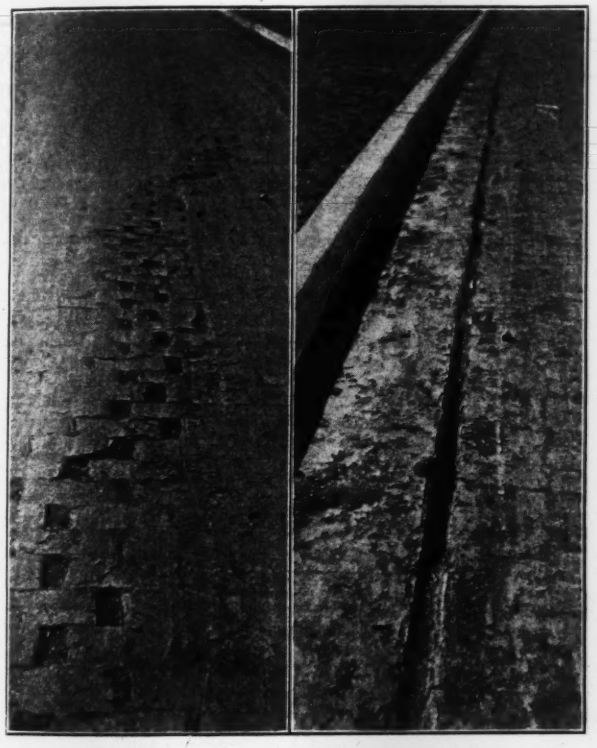


FIG. 2. TWO VIEWS OF THE CONCRETING BARGE; DERRICK BOAT IN LEFT VIEW

1914. There was no plant provided during a large part of 1914, and the spring of 1915 was used to assemble and build a plant. The work will take approximately two years more. It is being done under the direction of Maj. G. R. Spalding, District Officer. Capt. H. A. Finch is the army engineer on the project; E. P. Bone is resident engineer. The floating plant was designed by E. P. Bone and was constructed at the site under his supervision.

Texas Soil Requires Paving Base To Be Reinforced

Reinforcement for all concrete-pavement foundations is now the practice of the engineering department of the City of San Antonio, Tex. The experience of the last two years, during which about $2,000,000 has been expended for new pavements, has proved that most of the soil of



CRACKS IN SAN ANTONIO PAVEMENTS

(Left) Cracks due to poor subsoil conditions. (Right) Crack between combined curb and gutter and pavement

San Antonio is of such a nature that it is almost impossible to prevent the cracking of any paving material.

The subsoil is a sticky, black material when wet, and it cracks in drying, with the result that the concrete usually cracks too. When the dried soil again takes up water, it swells an appreciable amount. Successive wetting and drying enlarge even a hair crack in the pavement surface into wide breaks like those shown in the two views herewith.

To prevent such failures, the specifications were first changed to require that the concrete be laid on a 2-in. cushion of sand or gravel. More recently it has been decided to use wire-mat reinforcement extending from curb to curb. This specification includes foundations for wood-block, asphalt, brick and other types of pavement as well as concrete pavements.

To prevent the combined curb and gutter from breaking away from the pavement (as occurred in the case shown in the right-hand view), two ⅝-in. square twisted bars per section of curb (8 ft.) are inserted about 2 in. from the bottom of the concrete base. These reinforcing bars extend from 2 ft. beyond the outer edge of the gutter to within 4 in. of the back face of the curb. They are not bent up into the curb.

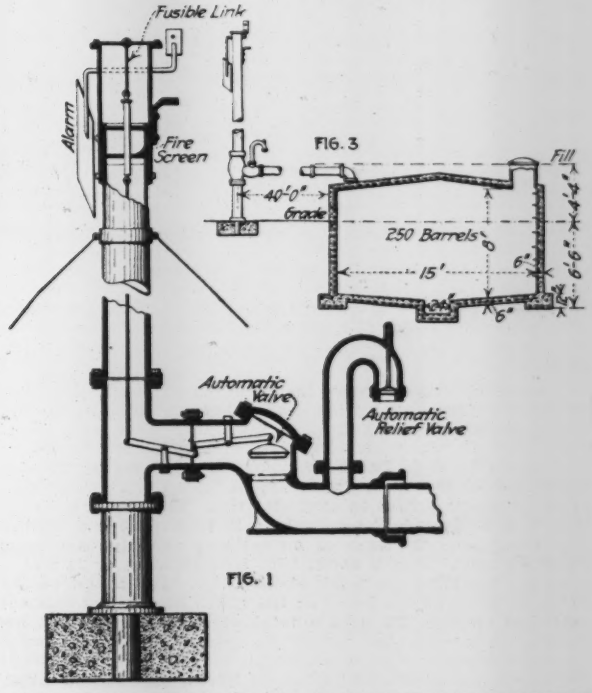
E. A. Kingsley is consulting engineer of the city in charge of pavement construction. Hans Helland is city engineer.

Underground Oil-Storage Tanks with Flameproof Vent

On account of disastrous experience in Oklahoma with loss of stored crude oil by lightning-caused fires (loss claimed to be a seventh of the production, so that insurance has reached the prohibitive rate of $6.50 per $100) a system employing underground tanks fitted with flameproof vents has been developed by W. W. Bowles, of the International Crude Oil Storage Co., Sapulpa, Okla.

Reinforced-concrete tanks have been designed in capacities up to 55,000 bbl. A special (patented) gum-varnish lining coat has been applied to make the tanks tight against oil and gasoline. A small tank (550-bbl. capacity) was recently subjected to a test fire and explosion, and the only serious damage was to the roof.

The important features of the safety vent (patented by Mr. Bowles) are the fire screen to prevent flame traveling through the vent pipe to the tank, as is possible with ordinary vents, an automatic self-closing valve between the vent pipe and the tank, an automatic alarm and a self-acting relief valve that will open automatically



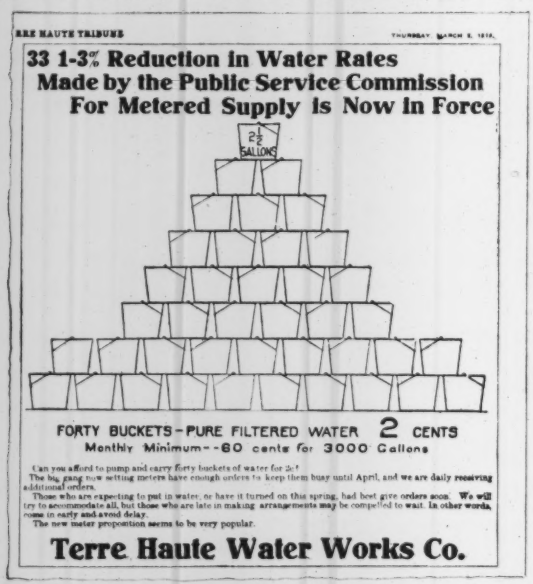
BOWLES UNDERGROUND OIL TANK AND SAFETY VENT

when oil is pumped out of the tank after the vent valve has closed. The flame stop is a simple device consisting of two fine wire screens with mineral wool or similar material between. The automatic closing valve and the signal act by gravity with the melting of a fusible link. The signal consists of a red disk or plate that revolves into an upright position by the fall of a counterweight, and its action sets off an electric alarm.

NOTES

Electric Tampers for Track Work were described and discussed in the Mar. 16 issue of "Engineering News." Attention has since been called to the fact that the manufacturer of the electric tamper is the Electro Magnetic Tool Co., of 2902 Carroll Ave., Chicago, instead of the Chicago Electric Tool Co. as printed. The Electro Magnetic Tool Co. builds a regular line of electric tools comprising drills, tampers and riveters. The electric tamper was developed by that company for the designer, G. W. Vaughn, Engineer of Maintenance-of-Way, New York Central Lines.

Advertising Metered Water Service—The Terre Haute Water Co., under the presidency of Dow R. Gwinn, is a past master in increasing its water consumption and revenues by advertising in the local press. Recently the state Public-Service Commission reduced the rates for metered water by 33⅓%. The company has seized the opportunity thus afforded

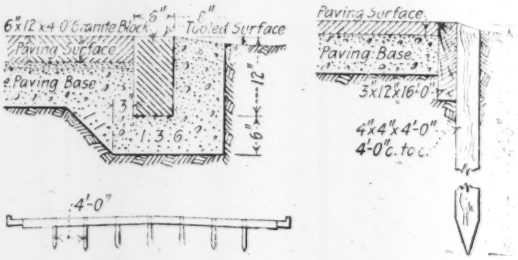

TERRE HAUTE TRIBUNE
THURSDAY, MARCH 2, 1916.
33 1-3% Reduction in Water Rates
Made by the Public Service Commission
For Metered Supply is Now in Force
2½ GALLONS
FORTY BUCKETS—PURE FILTERED WATER 2 CENTS
Monthly Minimum—60 cents for 3000 Gallons
Can you afford to pump and carry forty buckets of water for 2c?
The big gang now setting meters have enough orders to keep them busy until April, and we are daily receiving additional orders.
Those who are expecting to put in water, or have it turned on this spring, had best give orders soon. We will try to accommodate all, but those who are late in making arrangements may be compelled to wait. In other words, come in early and avoid delay.
The new meter proposition seems to be very popular.
Terre Haute Water Works Co.

BOOMING METERED WATER SERVICE AT TERRE HAUTE

to get new consumers. It has been running the advertisement here reproduced from a local paper. This has encouraged the editor to publish alongside the advertisement, which is on the editorial page, a number of brief letters from consumers telling how meters have reduced their water charges.

Three New High Records for Dredging in the Gaillard Cut on the Panama Canal were established on Feb. 18, in the 24-hr. period from midnight to midnight. The new 15-yd. dipper dredge "Cascadas" excavated and loaded into scows on that day a total of 23,305 cu.yd. of rock and earth. This is believed to be the world's record for a day's work by any kind of excavating machine in hard material. The actual working time of the "Cascadas" having been 23 hr. and 15 min. during the record day, the rate of output was slightly over 1,002 cu.yd. an hour. This is about 1,500 tons an hour, or 25 tons a minute. Including the work of the "Cascadas," a new record for excavation at the bases of the slides in one day was established on Feb. 18, with a total of 43,030 cu.yd. And including this work, the record for excavation in the entire Cut by dredges was broken, with an aggregate output of 55,979 cu.yd., the previous high record having been 48,622 cu.yd. Excavation at the bases of the Culebra slides, north of Gold and Contractor's Hills, during the week ending at midnight, Feb. 21, amounted to 267,255 cu.yd. In addition, 61,3[illegible] was rehandled by the pipe-line suction dredge "No. [illegible] the seagoing suction dredge "Culebra" and the Belgian [illegible] dredge "No. 5." The average aggregate output of the [illegible] in the Cut during the 17 weeks preceding that ending at midnight of Feb. 21 was 256,922 cu.yd., the total amount [illegible] primary excavation during that period (since Oct. 19) having been 4,367,680 cu.yd. This has been an average of 36,7[illegible] cu.yd. for each of the 119 days, or approximately 1,091,920 cu.yd. per month for four months.—"Canal Record."

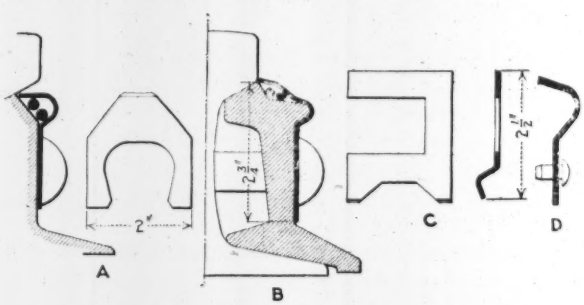
Bulkheads or Headers for Ends of Pavement—The accompanying illustrations show two types of pavement headers used in Houston, Tex. (E. E. Sands, City Engineer). The granite-block header is used where a permanent end is made of the paving operations, and it is designed, of course, to protect the end of the pavement. The temporary wooden header is used where it is expected to continue paving work



PERMANENT AND TEMPORARY PAVEMENT HEADERS, HOUSTON, TEX.

in the near future. The heavy clay soil of Houston makes substantial headers a necessity. Otherwise in wet weather there would be a considerable drop at the end of a hard-surface pavement, besides the likelihood of the subsoil washing out.

Clamps for Track Bond Wires—The clamps shown herewith are for securing and protecting bond wires at rail joints, where the wires are laid outside of the splice bars. They are of thin sheet metal and are made in various shapes to fit different splice bars and to protect bond wires laid above or below the bolts. They may be secured either by the track bolts or by small rivets. The clamp A at the left is that used by the Louisville & Nashville R.R. on 90-lb. rails, with bond wires carried along the upper side of the splice bar. It is held by the splice bolt, but can be applied without removing the bolt. The slotted hole enables the clamp to be slipped sidewise over the oval neck of the loosened bolt. It is then turned 90° to bring it into position, as shown. The clamp B is for use on heavy splice bars for the 100-lb. rails of the Pittsburgh & Lake Erie R.R., with wires laid on the top of the bar. The clamp C is for 100-lb. rails on the Boston & Albany R.R., where the wires are laid along the flange of the splice bar. This also is a slotted clamp. For application where new rails are being laid, a clamp of the washer type



CLAMPS FOR BOND WIRES AT RAIL JOINTS

is generally used, having a hole to fit the neck of the bolt. Clamps of this kind are bolted up tight, and the wires are inserted later. The clamp D at the right is of the riveted type and is used for 100-lb. rails on the electric lines of the Long Island R.R. A ⅝-in. hole is drilled in the bar (similar to holes for the channel pins holding the ends of the bond wires), and the tapered-end rivet is driven home. Similar clamps are sometimes riveted to the webs of the rails to secure the wires of signal connections. These devices are made by the P. & M. Co., Railway Exchange Building, Chicago.

Editorials

Missouri River Bank Revetment

The most interesting thing about the revetment work that the Atchison, Topeka & Santa Fe Ry. has been doing on the Missouri River above the Sibley bridge is its extent. While it is common practice for railways in that section of the country to engage in flood-prevention work to a considerable extent, it is doubtful if there is another instance where so extensive a program has been carried out for the protection of a single bridge. The summary of this work recently compiled (given in some detail on another page of this issue) accounts for the expenditure of about $250,000; but this is by no means all, as there is hardly a year that some patching and repair work is not done, and none of these small items is included.

The original Sibley bridge and approach cost approximately a million dollars, and recently as much more has been spent in double-tracking the approaches and in strengthening the bridge. Its peculiar location—just below a sharp bend in the river and above a creek, or slough—places the east approach in such a position that a sudden onslaught of the river might at any time isolate the bridge. Consequently, the railway company is under the necessity of keeping the channel where it now is.

Another interesting, and to some, doubtless, remarkable, phase of the problem is that the railway company has never received one cent of assistance for this work, or even engineering advice, from the United States Government. So strong is the sentiment of the river men against doing anything which will assist the railways that, although the law by a little stretching makes possible revetment work to protect other interests, there is no Government assistance possible to help maintain a very important transcontinental route. Of course, this is also true of similar railway revetment work in the Missouri and other Middle West river valleys.

To an engineer it would seem no stretch of the imagination to believe that the navigation interests of the Missouri would be well served by assisting in avoiding a catastrophe that would tie up the river channel for months. Certainly such assistance would be as valuable as protecting certain other stretches of the river where only agricultural lands are endangered.

The Conservative Rail Makers

Robert W. Hunt, the veteran engineer and metallurgist, has revealed the surprising fact that American rail manufacturers are so conservative that they hamper the effort to improve the quality of steel rails. In order to make a trial of a simple and promising way of insuring the selection of good rails and the rejection of bad ones it was necessary to go out of the country, to a Canadian mill. American rail mills would not try the new method.

This piece of news is a startling surprise to those who have believed in the superiority of the American steel industry over the European and who have thought that the reason lay in the constant aim of American steel makers to do things in new and better ways. The interesting question presents itself: What stood in the way of giving the Hunt method of rail selection a trial? Unfortunately, no anwer is at hand. All we are told is that the method could not secure a trial in American mills. It is hard to believe that mere tradition and routine were the obstacles.

Evidently, if the steel mills were thus ultra-conservative, they also had the power to insist on their own way. The influence which affects ordinary business—competition—does not appear to have been strong enough in this case. It was not a matter of being refused by one mill and succeeding at a competing mill. All the mills stood together, evidently.

The gratifying fact, however, is that the trial of the new method proved successful. Mr. Hunt reports that it eliminated many bad rails that would have gone into the track under the conventional methods of selecting and accepting rails. If on further investigation this turns out to be the regular effect of the new method of inspection, it will mark a very important forward step. It will give us safer railway track.

At the same time it will be a vindication for those men who have heretofore held out consistently in favor of testing every ingot poured. Their argument was that defective ingot structure is the chief danger to be feared rather than some mysterious factor of composition that could not be discovered by chemical analysis, but needed the drop test to reveal it. Mr. Hunt's method is essentially a way of examining every ingot. Though the examination is made only by visual inspection of a fracture of the rail, yet it is claimed to be adequate for detection of pipes and segregation.

New York Water-Meter Program

Water meters for every water consumer and the purchase of water meters by the city in accordance with its own "standard design and specifications" are two propositions just put out by the Department of Water-Supply of New York City that are likely to make the water-meter manufacturers and perhaps some other people as well sit up and take notice. A wide-awake attitude is all the more to be expected in view of an official statement to the effect that "the complete metering of the city under proper conditions will probably require not less than five years."

It can readily be imagined that the proposition to meter all water consumers in New York will be hailed by the water-meter manufacturers with considerably more satisfaction than the plan to adopt a standard New York water-meter design and specifications under which meters would be bought "from time to time under competitive bidding at a price not to exceed a maximum approved by the board." It may be, however, that such a conception of the attitude of the meter manufacturers does them an injustice. After giving the matter the very careful consideration which it most certainly deserves the manu-

facturers may possibly conclude that nothing could more effectively promote the use of water meters in the United States and Canada or do more in the long run to benefit water-meter manufacturers than to have a standard design for meters adopted by the leading city of the Western Hemisphere.

Doubtless the more timid among the water-meter manufacturers would fear lest such a move would rob them of some advantages in the way of claims to superiority for their own particular meter. The bolder manufacturers, however, may be expected to respond promptly to the opportunity for greatly increased output, feeling confident that business ability and well-merited reputation for excellent workmanship and for filling contracts on time will more than make up for any loss in their proprietary claims.

Whatever opinion may be held as to New York's plan to design its own water meters, the water-works fraternity throughout the whole country is sure to approve the earnest and intelligent effort now being made by the New York Department of Water-Supply to do away with its antiquated system of charging for water on the chance basis of building frontage and fixtures and to substitute the meter system—the only just and equitable way of selling water and an absolute necessity if an enormous amount of absolutely useless waste is to be prevented and adequate revenue is to be secured to meet the great cost of New York's new supply.

Government Plants for Making War Materials

There appears to be little doubt that the Government is about to embark on a large scale in the manufacture of war materials which it has hitherto purchased from private manufacturers. On Mar. 21 the Senate passed a bill appropriating $11,000,000 for the construction or purchase of a plant for manufacturing armor plate for naval vessels. The plant is to have a minimum capacity of 20,000 tons of armor per annum. That the bill will pass the House of Representatives seems practically certain, for that body is even more favorably inclined than the Senate toward the policy of Government ownership. Further, the attitude of the majority party in the House on this question was defined at a caucus of the Democratic representatives on Mar. 29. There were 120 present at the caucus, and a resolution was unanimously adopted instructing the Rules Committee of the House to report a rule "making in order amendments to the Navy, Army, Fortifications and Sundry Civil bills having for their purpose provisions for the Government manufacture of armament and ammunitions." There is no doubt that these votes in Congress reflect a widespread sentiment throughout the country in favor of Government ownership as a policy and especially of Government ownership of plants making war materials.

We need not take the space to discuss here the controverted question whether the Government should manufacture its own ship armor or have it made by contract at the existing armor-plate plants of the Bethlehem, Carnegie and Midvale companies. Those who desire can find 170 pages of such discussion in the report of hearings before the Senate Committee of Naval Affairs (Senate Document 1417). It may be briefly stated that the Bethlehem Co. offered to reduce its price for armor plate to $395 per ton, while Admiral Strauss, Chief of the Bureau of Ordnance, United States Navy, stated that detailed estimates made under his supervision showed that the cost of armor plate made at a Government plant of 20,000 tons per annum capacity and operated night and day year in and year out would be $230 per ton.

It is quite within the possibilities that other considerations may yet make it preferable for the Government to use its educated and experienced naval officers for other work than munition manufacture and leave that work to private enterprise. At present, however, the prevailing argument with Congress is the claim that work can be done at less cost by the Government than by private enterprise.

Most engineers of experience, especially those who have been in contact with Government work, are skeptical as to the claims for economy in Government as compared with private control. They well understand how easy it is to prove almost anything by cost figures, if one can only dictate how the cost figures shall be made up. A stock argument in proof of Government business efficiency is the operation of the Post Office Department, which is commonly claimed to be run at a profit. But in making up the cost of conducting the Post Office Department no charge whatever is included for interest and depreciation on the enormous investment which the Government has made in post-office buildings throughout the country. This is but typical, unfortunately, of the misleading character of too many statements of operating cost put forward by Government departments. These are among the reasons which have influenced many engineers to take very strong ground in opposition to the general policy of Government operation.

However well founded such opposition may be, there is another consideration which should be borne in mind. It is an engineer's business, according to the classic definition, "to use the great forces of nature for the service of man." Now one of these great forces is the force of public opinion. It is just as much the business of an engineer to take into consideration the force of public opinion in planning and carrying out his work as the force of gravity or of magnetism. The engineer who tries to run directly counter to the unseen force of public opinion is almost as certain to suffer failure as if he neglected to consider the unseen force of the wind in designing a great bridge.

It needs only the most casual acquaintance with the progress of events for the past 25 years, both here and abroad, and especially of the extension of government functions in the countries at war, to perceive that our own Government is destined to increase its field of work largely, no matter what political party is in control. The duty of the hour is to find ways and means of making Government work less inefficient and costly.

There are two main reasons why Government work is apt to be carried on less efficiently than a private business. The first of these is that the Government pays such meager compensation to the men in high positions that it cannot secure the men of greatest ability in competition with private concerns. Nothing is better established in the industrial world than that the success or failure of an enterprise depends more than anything else on the character and caliber of the men in its control. The Government, or any other employer, cannot expect faithful,

earnest service if it pays those who render such service a compensation so meager that energy, initiative and zeal are paralyzed. The annual report of the Secretary of Commerce gives figures as to the duties and the salaries of Government lighthouse inspectors. Congress in its wisdom (?) passed an act June 17, 1910, which provided that a lighthouse inspector shall be placed in charge of each lighthouse district and shall receive a salary of $2,400 per annum. In the average Government lighthouse district a lighthouse inspector has under his charge Government property of an average value of $3,000,000; he controls the operations of a force of 280 employees and of seven vessels, covering a coast line extending for about 1,000 miles, on which are established some 740 aids to navigation. He is responsible for the economical and efficient expenditure of about $304,000 per annum. He must have business and executive ability enough to carry on all this work, must have a knowledge of practically all branches of engineering and of nautical affairs, must be a man able to act on his own initiative and responsibility, since he is generally a thousand miles or more away from his superior officer at Washington—all this for $2,400 per year.

Here is another illustration of the way in which the United States Government recognizes efficient service: An appropriation of $5,000 was made a few years ago for the survey of a river whose improvement was contemplated. The United States Assistant Engineer who was placed in charge of the survey was able so to plan the work of a dozen men under his direction that they executed the survey at odd times when other work in the district was not pressing, so that no part of the $5,000 was expended and it was returned to the Treasury. When he reported what he had accomplished, with some pardonable pride, to the officer in charge of the district, that officer, who was stationed some distance away, sent the engineer an appreciative letter telling him that his salary for the year would be raised $25. The assistant engineer did some thinking and replied with a letter of thanks and his resignation.

Let us cite another and typical illustration for the benefit of those who cling to the idea that Government work is carried on efficiently and economically especially when it is in change of army or navy officers.

As is well known, certain large financial interests have expended enormous amounts during the past year in the construction and equipment of plants for munition manufacture. One great difficulty has been to find men to put in charge of these plants who were in any degree familiar with munitions. It happens that in this effort a number of young army officers who had had a West Point education and a few years of army experience have been placed in charge of large manufacturing plants. It is scarcely derogatory to the character and ability of these young men to say that the results were what might have been expected. They had had so little experience in the management of men and the conduct of modern manufacturing operations that the whole enterprise would have ended in disaster had it been conducted under ordinary commercial conditions.

It is fair to say, too, that this occurrence illustrates also how far from ideal are the methods of operation often followed in industries carried on under private management. The private business that is inefficiently managed, however, will sooner or later find its way to bankruptcy, while inefficient management in the Government business is reflected only in increased burdens on the taxpayers.

There is another reason why Government work is likely to be inefficient and costly compared with private work. A recent notable illustration is the report presented to the New York legislature by Senator Horton, presenting the results of a study of the conditions of employment in the New York State service. It is stated that, notwithstanding the existing civil-service laws and the efforts made for a quarter-century past to improve the character of work done by the state, it is still a fact that the state is paying out many hundreds of thousands of dollars every year in salaries and wages for which it receives little or no return. Congress and the state legislatures are pretty sure to practice cheese-paring economy when they fix the salaries of the men in high and responsible positions; but when it comes to the wages and conditions of employment of the rank and file of the workers, especially those who may be given places for political reasons, the generosity of the legislators is boundless.

New demands are constantly being made upon our legislative bodies by organized labor. A good example is the bill now pending in Congress which forbids the use of scientific management in the Government service. This bill provides that any officer, manager, superintendent or foreman who shall make a time study of the work of any Government employee shall be guilty of a misdemeanor and further provides that no premiums or bonus or cash reward shall be paid to any employee in addition to his regular wages.

Most engineers are more or less familiar with the work which has been done by scientific management in reducing the cost of production in manufacturing plants and at the same time increasing wages and improving conditions of work, so that the employees are better satisfied and better paid than they were under the old system. If we are to have in the future a large extension of Government activity in industry, it is more than ever necessary that the Government shall be able to use the same methods for securing efficient production that have been well established as successful in the work of private manufacturers.

Co-operation Among Technical Societies; Its Limitations

Announcement has been made of the meeting to be held next week in Chicago by representatives of a number of engineering societies to discuss the general subject of co-operation. It is apparent that the term coöperation is merely chosen for want of a better name. What the conference is really to discuss, as we understand it, is the general question, "What can the engineering profession do to better the conditions under which it is working?" Numerous conditions in the profession have been a source of complaint for years. The individual engineer realizes his inability to change these conditions. The question is to what extent engineers associated together may be able to better these conditions.

To take an example: The individual engineer cannot advertise his business on any considerable scale. Even if there were no other reason, the margin of his earnings over expenses is not sufficient to permit such advertising.

There is a need, however, that the public should be better informed as to the services which engineers can render when given a free hand to do work in the best way. Can engineers united in an organization carry on such advertising work, so that the members of the organization may have more work to do and be able to do it under better conditions?

For another illustration, take the matter of securing a position for the engineer out of employment. Nine-tenths of the members of the engineering profession, probably, are employed on salaries. Changes are inevitable and frequent, especially in construction work where the end of one piece of work means that those employed on it must find positions elsewhere. It is with great difficulty that a man who is out of a job can himself hunt up a position or directly offer his services without, to some extent at least, seeming to lower his market value. Can this work be effectively done by an engineering society for all its members?

A similar question interests engineers in private practice who seek engagements from cities, corporations and other clients. There is frequent inquiry from those who desire to engage engineers as to where the right one can be found to handle a particular job. Can an engineering society adopt means to gain such reputation and standing among those who employ engineers that it would be habitually resorted to by applicants?

These are but samples of the questions which are being discussed by engineers everywhere; and it is a large group of questions of this sort which the word "coöperation" is intended to cover.

There is in the minds of many, however, an idea that there is some other significance to the so-called coöperative movement; that some sort of merger or federation or amalgamation is sought between different engineering societies or that united action of all the different societies is necessary in order to effect the ends desired.

It seems to *Engineering News* that this is a mistaken view of the matter. The various engineering societies—state, local and national—have been developed by a process of evolution. If they had not fulfilled a need of the profession, they would have dwindled and disappeared. That there have been an over-multiplication of societies and a certain amount of overlapping functions is doubtless true; but to regard the different societies as rivals or competitors of each other is to take a narrow view of the matter.

Similarly, the development of the national societies devoted to different branches of engineering was as inevitable as was the original formation of the oldest of the national societies—the American Society of Civil Engineers. There is unfortunately considerable misunderstanding on this last point. Among some of the older members of the profession the idea still clings that, because the term "civil engineer" originally included all branches of the profession except the military engineer, therefore the parent Society of Civil Engineers ought to have continued to comprehend the entire engineering profession.

Those who cling to such an idea ignore the specialization that has taken place in the engineering profession and that is still going on. This specialization has resulted not merely in the development of half a dozen great national societies instead of one, but in the development of a great number of societies devoted to special branches of engineering work. The American Society of Mechanical Engineers, for example, notwithstanding its formation of sections devoted to special branches of mechanical engineering, has witnessed the organization of half a dozen independent societies devoted to particular branches of mechanical-engineering work.

Coöperation among the different national societies, great and small, is doubtless desirable in some matters; but it has yet to be shown that anything in the way of federation or amalgamation with attendant complications of the governmental machinery of these societies would be of benefit to the profession.

It is frequently urged that, if engineers of all branches of the profession would unite in supporting some particular scheme or policy, their combined influence would be of great weight. It will be found, however, on close examination that the questions are few on which the governing bodies of the different societies could unite and claim really to represent the great bulk of their membership.

To take a concrete example: A bill is before Congress at the present time making compulsory the use of the metric system. The American Institute of Electrical Engineers would doubtless be ready formally to support such a bill, but it is almost equally certain that it would be strenuously opposed by the American Society of Mechanical Engineers.

The American Institute of Mining Engineers would be deeply interested in the amendment of laws governing titles to ore deposits; but so few members of the other national engineering societies are interested in or informed on this matter that they could not be expected to take an interest in such legislation.

If coöperation among engineering societies is to be successful, then, it must be limited to subjects on which the members of the several societies can unite with a fair degree of unanimity. Questions that affect the profession as a whole, such as legislation to restrict the right to practice or changes in engineering education, are examples of questions that interest engineers of all classes and on which coöperative action should be easy to secure.

It may be added that the committee in charge of the Chicago conference invites suggestions from any engineer as to practical methods by which engineering societies, either independently or in coöperation, may work more effectively for the benefit of the profession.

There seems to be a general impression that reinforcing rods stripped clean of concrete at a break in a reinforced-concrete failure are proof of green concrete. Investigators, in fact, are apt to take such a condition as primary evidence that the concrete had not set and to search for some cause that would explain such weakness. It is more than doubtful, however, that such an assumption is warranted. The writer of this note has seen nearly every reinforced-concrete failure of any size in the last ten years, and he can not recall a single case in which somewhere in the structure there were not long stretches of bare rods hanging down from firm embedments in the standing remnant. In many of these structures the concrete was above criticism.

The fact is that, under shock of collapse, steel tensile resistance or sufficient embedment will prove stronger than adhesion and that a firm, well-set concrete will strip clean from rods to which it has an adhesion far beyond that necessary for a proper transmission of normal stress.

Letters to the Editor

Credit for the Strengthening of the Cairo Bridge

Sir—The article published in *Engineering News* of Mar. 9, giving a description of the strengthening of the bridge of the Illinois Central R.R., over the Ohio River at Cairo, Ill., failed to give credit to J. M. Johnson, consulting engineer, Louisville, Ky., who is the consulting engineer of bridges of the Illinois Central R.R., for the ingenious design through which this work was carried out under the supervision of himself and the Engineer of Bridges, C. C. Westfall. I will be obliged if you will take the first convenient opportunity of making a note of this.

A. S. Baldwin,
Chief Engineer, Illinois Central R.R.

Chicago, Mar. 27, 1916.

Engineers' Military Fitness; Military Sanitation

Sir—I notice with great interest the correspondence in *Engineering News* of Feb. 24 and Mar. 9 relative to the military fitness of New York State's engineers. The authors of the later letters, to my mind, have both missed the point of the original letter by "Vet." I think that this, instead of conveying any aspersion on the ability, integrity or patriotism of the engineers in the employ of the state, may be more properly interpreted as seeking to correct a popular misapprehension that quite certainly exists, even among engineers.

The special training and experience which engineers receive undoubtedly do make them better qualified than any other body of men that could be selected as raw material out of which to form efficient military men. But it is an error to assume that this special training in and of itself fits them for military service. The sooner engineers come to realize (if they do not realize it now) that, in order to meet their duty and obligation and to justify the confidence reposed in them by the public, they should undertake seriously the business of learning something of the varied and strenuous duties of military service under modern war conditions, the better it will be for the engineering profession and for the public at large.

It is interesting to observe that in the Chief of Engineers' list of books in relation to military engineering, appearing in *Engineering News* of Mar. 16, there is little, if any, mention of the two very important subjects of military water-supplies and sewage disposal. The only title on these subjects included in the list is that of Washburne's "Military Hygiene." These are two matters in which civil engineers, even those without special military training, may be of very great help in the successful conduct of war operations.

At the outbreak of the present European War a distinguished engineer of long experience in East Indian service prepared a brief code of rules for use by officers in the field in relation to the selection, purification and distribution of water to scouting parties, men in the trenches and in encampments. This code included simple tests that an ordinary private could utilize to determine the probable safety of a source of water-supply and also contained instructions for simple sterilization and purification of questionable waters by chemical dosage. Whether or not the necessary pills or lozenges were supplied to the field officers and the method put into practical use, I am unable to say.

Studies by the United States Geological Survey a number of years ago seemed to indicate clearly that a great deal could be accomplished with the field assay of water by similar methods. The subjects of water-supply and sewage disposal in military service are deserving of more attention from civil engineers than they have hitherto received. Furthermore, the treatment of these subjects should come properly from engineers in a larger degree, it having apparently been left hitherto largely to physicians and surgeons.

Robert E. Horton.

Albany, N. Y., Mar. 18, 1916.

Paving Blocks Treated with Water-Gas Tar

Sir—I have been much interested in the comments made by J. S. Miller in your issue of Mar. 2 on the subject of water-gas tar in the treatment of wood-paving blocks, particularly in the sentence that reads: "It is regrettable that such an extensive and painstaking investigation of this subject as Dr. Von Schrenk undoubtedly made did not include a greater yardage of blocks treated with water-gas tar, as millions of such blocks have been laid in the past nine years, to the writer's knowledge . . ."

It will be of interest to your readers to know that the chief reason why so little has been done with water-gas tar, in the way of making examinations, is that up to the present time the knowledge as to the exact locations and the treatments given wood blocks with water-gas tar is so extremely limited that it has not been possible to make any investigations. In spite of repeated requests, made both on the floor of the convention of the American Society of Municipal Improvements and elsewhere, no data have been forthcoming concerning the treatment of wood blocks with water-gas tar which would make possible an examination of such pavements. The American Railway Engineering Association has for the past six years had various committees on water-gas tar, all of whom have reported year after year that they were unable to find any materials treated with water-gas tar the data of which were authentic enough to warrant an investigation. It is therefore very gratifying to note from Mr. Miller's communication that there is a large number of blocks treated with water-gas tar which he knows of, and I am sure that he would be conferring a favor upon everyone interested in wood-block pavements if he would

kindly send an authentic list, together with data as to the time and manner of treatment, either to myself as chairman of Committee D-7 of the American Society for Testing Materials or to Earl Stimson, chairman of the Committee on Wood Preservation of the American Railway Engineering Association.

The difficulty with the use of water-gas tar is that no one has been willing to come forth and give the data which have been available for coal-tar creosote for so many years and upon which our present faith in coal-tar creosote has been largely based.

HERMANN VON SCHRENK.

Tower Grove and Flad Ave., St. Louis, Mo.
Mar. 13, 1916.

What Is a Cast-Iron Special?

Sir—A question has recently come up on a water-main contract of approximately $500,000 which seems to merit discussion. The work was done under a unit-price proposal, and the question hinges on what constitutes a "special."

The specifications called for the contractor to furnish, haul and lay cast-iron pipe at a bid price per ton and to furnish, haul and lay cast-iron specials at another bid price per ton. The straight pipe was to lay about 12 ft., and the specifications gave the approximate number of 12-ft. lengths required; also the approximate number of tons of specials required.

In the actual construction a considerable quantity of the straight pipe had to be cut and fitted to valves and specials. This involved a considerable outlay, as the bulk of the work was 48-in. pipe in which the cutting was expensive and the number of extra joints so required ran into considerable money. The 48-in. joints were 3½ in. deep and cost about $9 each. Under the specifications the waste cut pipe under 6 ft. in length was a total loss to the contractor. The question therefore is: Does the cut pipe, involving an extra joint and a loss of the waste end, constitute a special?

EARL M. SEITZ.

Camden, N. J., Mar. 15, 1916.

Power Plant for Government Buildings in Washington

Sir—Referring to the editorial on "Power Plant for Government Buildings in Washington," in your issue of Mar. 2, I desire to call attention to one or two expressions in it through which the reader might receive an erroneous impression.

You say: "The Secretary of the Treasury employed the firm of L. B. Stillwell & Co., Engineers, of New York, to go over all that had previously been done, recommend any desirable changes and prepare plans and specifications for the work." As a matter of fact, the site had been fixed by Act of Congress, and we made no study of its merits as compared to that of possible alternative sites. We were informed that the act was mandatory, that the plant was to be erected, and that it was to be erected upon the site named in the act. The work of the members of my organization, who for a time were carried upon the rolls of the Supervising Architect's office, was limited to a consideration of the mechanical and electrical features of the plan upon which the report of the department engineers had been based and to the preparation of plans and specifications covering mechanical and electrical equipment and the power house, in so far as it was structurally related to such equipment.

The fact that the plans were not submitted to the Fine Arts Commission before the contract was closed is ascribed by you (following a statement by the Treasury Department which has appeared in the public press) to "the fact that the detailed plans were prepared by an engineer outside the department." The representatives of my firm in Washington were carried upon the department payrolls, upon a *per diem* basis. They assumed, and could properly assume, no executive responsibility in respect of submission of plans to the Fine Arts Commission or to anyone else. The responsibility for such submission rested with the officers of the Treasury Department and particularly with the Supervising Architect's office. The men whom my firm lent to the department would have ventured beyond their province had they undertaken to act in this matter.

You say: "It has developed as a result of the agitation that the plans for the new power station are inadequate, having been made to fit a limited appropriation instead of planned to meet the actual needs, ornamental as well as economic." The plans which were prepared under the supervision of my firm cover an equipment entirely adequate, but I understand that in closing the contract the department has agreed to the omission of a considerable part of the apparatus specified, in order, as you say, to fit the limited appropriation.

Your question, "Why should a power station be a hideous object?" is a fair one, and you are right also in saying that the towering chimneys are not essential. As a matter of fact, my associate, Mr. Putnam, who was in immediate charge of this work in the Supervising Architect's office, suggested the omission of the stacks and the use of forced draft with economizers. It was decided by the Supervising Architect that the stacks should be used, in order to minimize the cost of the plant and, if possible, construct it within the limit of the appropriation.

LEWIS B. STILLWELL.

100 Broadway, New York City, Mar. 21, 1916.

NOTES AND QUERIES

Good-Roads Day in Pennsylvania has been set for May 25 by Governor M. G. Brumbaugh. Citizens of the state are requested to work on the roads in their vicinity on that day or else give money or material for good-roads work.

Steel Centers on Susquehanna Bridge—Supplementing the description of construction work on the Cumberland Valley R.R. bridge over the Susquehanna River at Harrisburg, Penn., "Engineering News," Mar. 23, 1916, p. 537, information has been received that the steel collapsible centers used were designed and built by the Blaw Steel Construction Co., Pittsburgh, Penn.

Definitions of Stress and Strain—In comment upon the letter of Henry B. Seaman, published in "Engineering News," of Feb. 10, criticizing the current use of the terms "stress and strain" in bridge engineering, F. H. Frankland, of Lake Charles, La., opposes Mr. Seaman's position. Mr. Frankland refers to standard treatises, such as that of the late Prof. A. J. Du Bois, which define stress as the applied force and strain as the deformation of a member resulting from the application of the force. He urges that, as these definitions have for more than a quarter of a century been generally accepted by structural engineers, it would be a serious mistake at the present time to attempt to alter them.

Trial Activated-Sludge Unit at Cleveland, Ohio

By R. Winthrop Pratt*

As a result of an extended study of the sewage-disposal problem of Cleveland (see *Engineering News*, Feb. 13, 1913, and also "Report on Tests at Sewage-Testing Station," 1914) it was recommended that sewage from the northeasterly section of the city, comprising about 50% of the total sewage, be treated at works to be located adjacent to the present outlet of the easterly interceptor. (See *Engineering News*, Mar. 28, 1912.) The report recommends that such works provide for:

The removal of the suspended inorganic matter or grit. Chambers capable of detaining the sewage for a period of 50 sec. at velocities ranging from 30 to 60 ft. per min. would prove sufficient to accomplish the desired result.

The removal of grease and oil by means of scum boards.

The clarification of the sewage by tank treatment. At a slightly increased cost it is possible by tank treatment to obtain with the easterly sewage an effluent better than that obtainable from fine screens. Tanks of the two-story type, designed with a nominal detention period of 30 min., would prove satisfactory.

The disinfection of the tank effluent. This treatment should be carried out at least during the bathing season. The application of five to seven parts of available chlorine per 1,000,000 gal. of clarified sewage will be necessary. Due to the fact that favorable progress recently has been made in the use of liquid chlorine as a disinfectant, it is believed that this process should be considered in a final selection.

An outlet system which will discharge the treated sewage effluent into water 30 ft. deep, at least ½ mi. off shore, and disperse it over a large area by means of many individual outlets.

Drying the sludge within inclosed structures.

The final disposition of the dried sludge. This material can be used as a filling material in isolated localities or for a fertilizer ingredient, if such use proves to be economical.

*Consulting Engineer, Department of Public Service, Cleveland, Ohio.

FIG. 1. ACTIVATED-SLUDGE UNIT, CLEVELAND, OHIO

Sludge-activity tank is in center foreground and is receiving activated sludge from settling compartment. Air-supply pipes to the various compartments are shown; also air lift in sedimentation tank

On the basis of these recommendations general plans were prepared for a system of two-story sedimentation tanks, and it was planned to protect the works by a stone breakwater about 2,000 ft. long parallel to the city's property and 600 ft. off shore. This breakwater, which has already been built, will enable the reclamation of some 25 acres of land, a portion of which it was planned to use as a site for the tanks.

Early in 1915, owing to the fact that no funds were available for building the proposed treatment plant and due to the apparent advantages of the activated-sludge

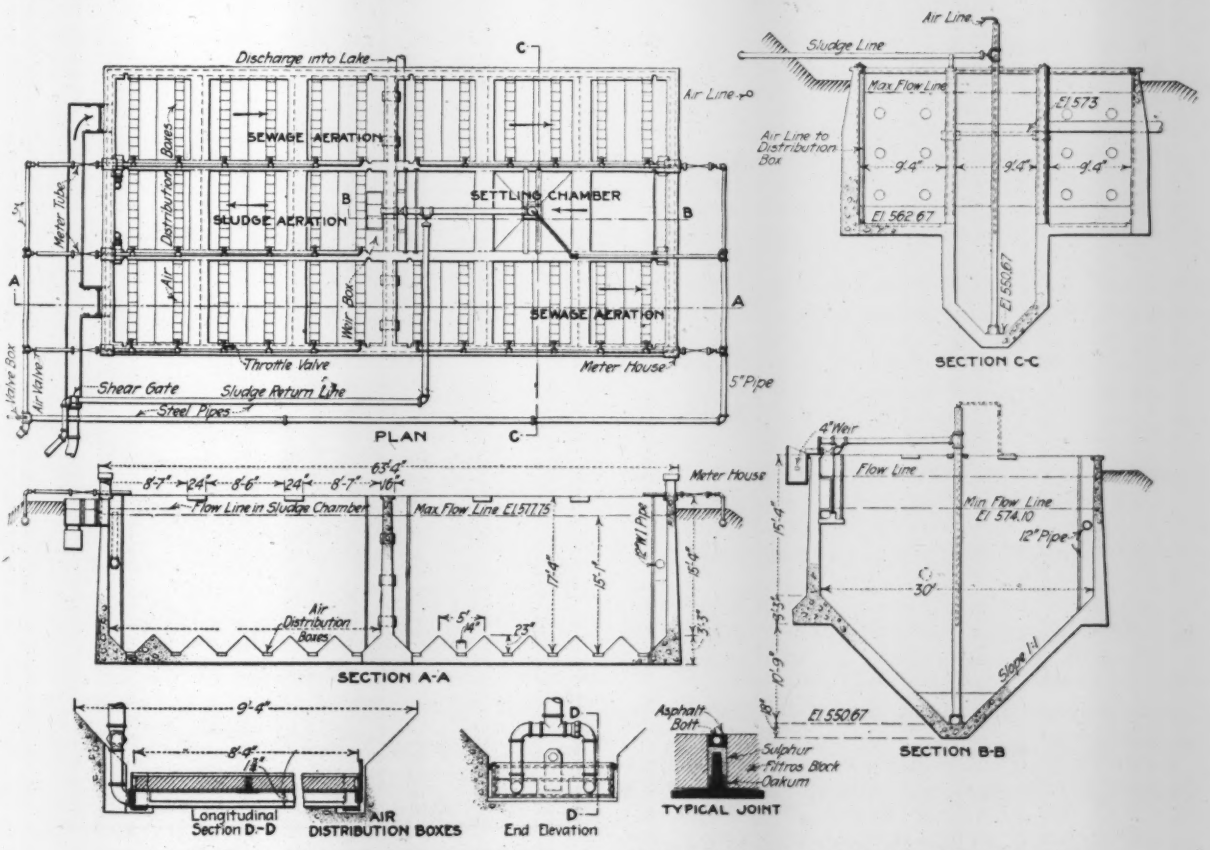


FIG. 2. DETAILS OF FIRST WORKING UNIT ACTIVATED-SLUDGE TANK, CLEVELAND, OHIO

process of sewage treatment which was first given prominence in the country about that time, the city began tests of this process, using as far as possible the equipment on hand at the testing station. These tests were described in *Engineering News*, July 22, 1915.

Realizing, however, that a much larger-scale test was essential before adopting this new process for an 80,000,000-gal. plant, plans were made in September, 1915, for constructing a 1,000,000-gal. aëration tank so designed and located that it could readily be made a part of a future 80,000,000-gal. activated-sludge installation or be remodeled at minimum cost and made a part of a two-story tank installation, in accordance with plans already prepared as previously mentioned.

This preliminary unit was completed about Jan. 25, 1916, and has been in operation to date. The tank is operated upon the continuous-flow principle. On a 1,000,000-gal. basis the aëration period is 4 hr. (2 for sewage and 2 for sludge), and the settling period is ½ hr.

The tank is 30 ft. wide, 60 ft. long and 15 ft. deep, except that the sedimentation compartment is deeper. The tank is divided into six compartments, each 9½x30 ft.—four for aërating sewage, one for maintaining the activity of the settled sludge and one for sedimentation. (See Figs. 1 and 2.)

The inlet and outlet connections of the various compartments are so arranged that it is possible to secure a minimum sewage-aëration period of ½ hr., in case it is found desirable to operate the tank at a high rate.

Air is furnished by a motor-driven hydro-turbine compressor and distributed by means of "Filtros" blocks fastened in steel frames in the valleys of the ridged bottom. The total area of Filtros blocks is 25% of the total area of the bottom of the tank. The quantity of air used is automatically recorded and the electric current is metered.

In spite of the fact that the operation of this unit was commenced in cold weather a well-clarified effluent was produced 10 days after starting and has been maintained ever since. It is planned to operate the unit with the idea of obtaining a clarified but not necessarily a nitrified effluent, as it is believed the former, in view of the conditions governing ultimate disposal into Lake Erie, will meet all local requirements.

The production of such an effluent with the use of a moderate amount of air appears to be feasible; but a very important phase of the process, and the one which will probably govern its adoption, is the problem of disposing of the sludge. This is formed in quantities as great as 20 cu.yd. per 1,000,000 gal., on a basis of 97½% moisture, and must be dried or disposed of promptly in order to avoid a nuisance. Tests are now being made on dewatering this sludge by means of sand filters and centrifugal machines.

Numerous determinations of the ammonia content of the sludge have given consistently results of about 4%, or 4½ units dry basis. Assuming that each unit of ammonia in the sludge is of equal value to each unit in garbage tankage, the market price of the sludge should be about $8 per ton.

Robert Hoffmann, Commissioner of Engineering and Construction, Cleveland, is in general charge of all sewerage and sewage-disposal improvements. The work herewith described is under the supervision of the writer, with George B. Gascoigne in immediate charge.

Long-Span Steel-Arch Bridge Across Colorado River

The Needles bridge, across the Colorado River between Arizona and California, near Needles, Calif., which was dedicated on Mar. 25, is the third longest steel arch bridge span in the United States. Its 592-ft. arch is surpassed only by the 840-ft. Clifton arch at Niagara Falls and the 977½-ft. Hell Gate arch at New York City. This new highway bridge is the second highway crossing of the Colorado in the 1,000 miles from its mouth in the Gulf of California. It is, as will be seen from two of the accompanying views, very near the Santa Fe Ry. bridge over the river.

The Needles bridge is a three-hinged braced steel arch, 592 ft. c. to c. of end pins and with 100-ft. rise. The floor, a 22-ft. highway, is suspended from the arch ribs in the middle of the span and supported by posts at the ends. Approaches at each end, of 56 ft., make a total floor length of 832 ft. The end hinges are of the ordinary pin type, but the center hinges are of the ball-and-socket type with a spherical compression bearing.

The method of erection was unique. The trusses from both the California and Arizona sides were built with the crown end resting on temporary pilework in the middle

FIG. 1. ERECTION TOWER IN PLACE ON NEEDLES BRIDGE ACROSS COLORADO RIVER

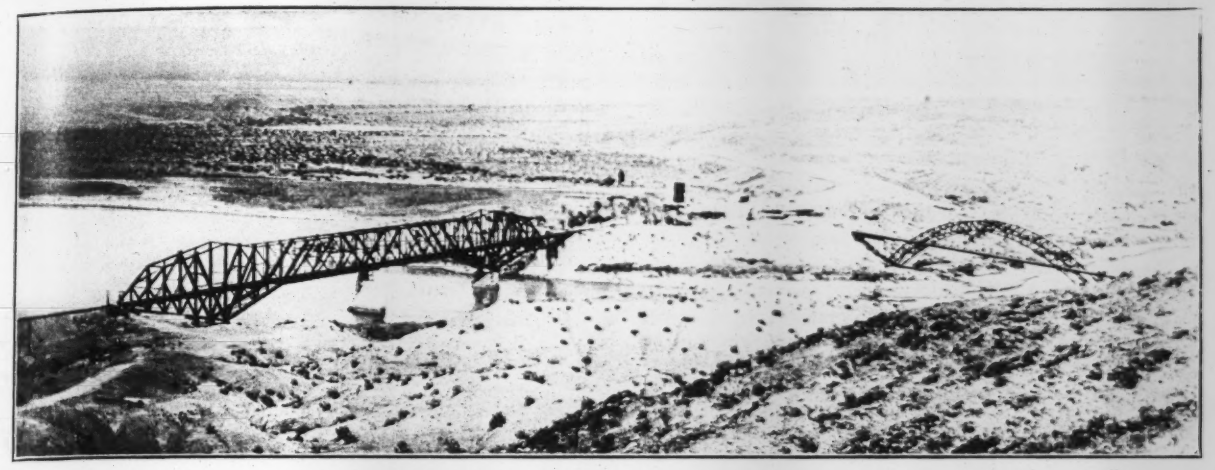


FIG. 2. COLORADO RIVER AT TOPACK, ARIZ., SHOWING SANTA FE RY. BRIDGE ON LEFT AND NEW NEEDLES HIGHWAY BRIDGE ON RIGHT

of the river and with the end hinges in place against the abutments. One truss was built so as to rest on the other, as shown in Fig. 1. The tower for hoisting the trusses to make the center-hinge connection was built from the material that was later used in the floor system. Sufficient end bracing was left from each truss to allow it to be hoisted into position without striking the tower, which was slightly narrower than the width of the trusses. The bridge was designed by J. A. Sourwine, County Surveyor, San Bernardino County, California. The steel was fabricated and erected by the Kansas City Bridge Co. J. P. Kemmerer was the construction engineer in charge of the work. The total cost of the bridge, exclusive of the concrete wing walls for the abutments, was $75,500. The Federal Government, the State of California and the State of Arizona each contributed $25,000, while the balance was furnished by the County of San Bernardino.

Interurban Entrance and Rapid Transit Plan in Cincinnati

By M. W. Rew*

The Miami and Erie Canal from Toledo to the Ohio River, at Cincinnati, Ohio, runs through the City of Cincinnati from its north corporation line to the river. Except for about half a mile, which has been sewered, the whole length is an open canal, unsanitary, unsightly and practically unused. It has long been the wish of the people of Cincinnati to eliminate this eyesore and make use of the right-of-way for some purpose beneficial to the public. Numerous suggestions have been made, the more noteworthy being an entrance for railroad lines, an entrance for interurbans and rapid-transit line or a boulevard.

At the present time Cincinnati is greatly handicapped by the fact that many of the interurbans coming to the city have their terminals in the suburban districts, and all freight and passenger traffic must reach the heart of the city by other means. This condition is due to the fact that some of the lines use a 5-ft. 2½-in. gage, while others have the standard 4-ft. 8½-in. gage.

*Assistant Engineer, City of Cincinnati.

The topography of the country is of so rough a nature that the population per square mile is much less than that of the average city (about 70 sq.mi. for a population of 400,000 people), requiring much longer average street-car rides than is the usual case. The fact that the suburbs can be reached only by certain arteries of travel—through valleys along which reasonable grades to the hills may be obtained—causes congestion of street-car traffic.

As a result of these conditions there is a pressing need for a rapid-transit system that will provide quick and easy access from the suburbs to the business district, together with a feasible entrance for interurbans to a common freight and passenger terminal in the heart of the city. In the summer of 1913, careful surveys and designs for an interurban entrance and rapid-transit system were made, together with estimates of the cost.

The proposed scheme is a belt railway through the business district and following the canal on the west to the north side of the city. On the east the proposed line follows the river bluff and certain ravines, which afford an economical means of construction, to the northeastern section of the city. The belt is completed by a high-speed surface crosstown line connecting the termini of the rapid-transit line. It is planned to replace this surface line at some future date with a rapid-transit line, thus

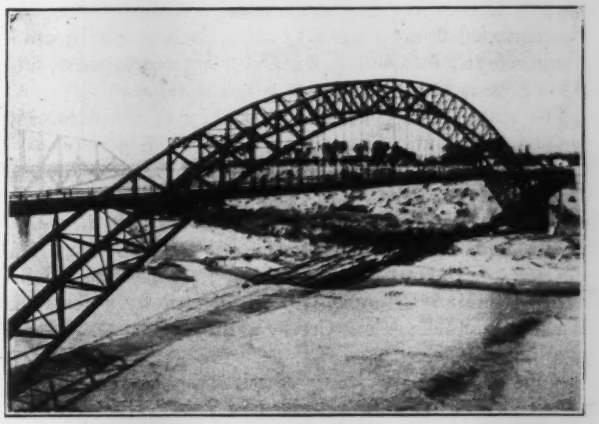


FIG. 3. NEEDLES BRIDGE ACROSS COLORADO RIVER BETWEEN CALIFORNIA AND ARIZONA
Third largest steel arch in the United States

completing the rapid-transit loop. Freight and passenger terminals for interurbans, of ample capacity to provide for the increase in business for many years in the future, have been provided in connection with the system.

A Rapid Transit Commission appointed by the mayor in November, 1915, has adopted the plan as outlined, and the City Council has passed a resolution authorizing a bond issue of $6,000,000 for the purpose of constructing such a system. A referendum election on the bond issue will be held at the time of the presidential primaries, on Apr. 25, 1916. If the decision of the people is favorable, contract plans will immediately be started for such a system, and at the same time the commission will perfect a lease with an operating company.

Many important steps now proposed will lead to a larger and better development of the city, and the plan for interurban entrance and a rapid-transit railway is among the most important of these.

F. S. Krug, City Engineer of Cincinnati, is also Chief Engineer of the Board of Rapid Transit Commissioners.

Final Flood-Protection Plan for Miami Valley

Twenty million dollars is to be spent for five dry retarding basins and costly channel improvement in the valley of the Miami River and its tributaries, according to the final plan submitted by the engineers of the Miami Conservancy District to the directors of the district. A hearing will be held by the directors, Apr. 10, to canvass any objections to the plan. If there are objections, the plan may have to go before the Conservancy Court; otherwise it stands approved and is ready for the work of the appraisers. There will be another hearing on the appraisers' report, probably during the coming summer.

The five dams will consume two-thirds of the construction cost of the entire project. The construction cost itself, however, amounts to only one-half the total expense, the other half being made up of real estate, damages to railways and other public services, general expense and contingencies, etc.

Local river-channel improvement and the construction of levees at some locations are provided for to the extent of about half the cost of dam construction. The purpose of this work is either to make the channel of sufficient capacity to pass the regulated flow of the river or to furnish levee protection for a height corresponding to the regulated flow. Channel enlargement or rectification is not everywhere possible without too great expense, and in such cases the levee plan is resorted to.

The map opposite shows the location of the detaining basins. They are situated at Lockington, on Loramie Creek, below the Loramie reservoir; at Taylorsville, on the Miami, between Troy and Dayton; above Englewood, on Stillwater River; at Huffman, on the Mad River; and above Germantown, on Twin Creek. The position of Dayton, at the confluence of Miami, Stillwater and Mad Rivers, is thus protected by a reservoir in each channel. Wolf Creek, a mile lower down, will have no storage.

Some data on the storage basins were given Mar. 9, page 485. Fuller data are given in Table 3 herewith.

The entire area of the Miami River drainage basin of 4,000 sq.mi. was carefully studied after the 1913 flood, with respect to maximum flood flow and height. The longitudinal slopes of the rivers are not uniform, but they average as follows: Miami, 3⅓ ft. per mi.; Stillwater, 4⅓ ft. per mi.; Mad, 6 ft. per mi.; Twin Creek, 8 ft. per mi. With these slopes, a stepped profile and irregular channel dimensions, great care was required in securing estimates of maximum flood flow. Kutter-formula computations on straight sections of the valley where flood slopes could be obtained and special computations made at contracted sections where the longitudinal drop on a short distance could be measured accurately were employed to calculate flood flow.

TABLE 1. PRESENT CHANNEL CAPACITIES IN THE CITIES OF THE MIAMI VALLEY COMPARED WITH THE 1913 FLOOD DISCHARGE

City	Channel Capacity, Sec.-Ft.	Flood Discharge, Sec.Ft.	Ratio, Per Cent.	Drainage Area, Sq.Mi.	Remarks
Sidney	10,000	44,000	22.7	555	High banks, small levees in places
Piqua	25,000	70,000	35.7	842	Above Pennsylvania R.R. small levees
Troy	20,000	90,000	22.2	908	To top of levee above railroad
Dayton	90,000	250,000	36.0	2,525	Above Wolf Creek levees
Dayton	100,000	252,000	39.7	2,598	Below Wolf Creek levees
Miamisburg	65,000	257,000	25.3	2,722	Cincinnati, Hamilton & Dayton Ry. fill acts as levee
Franklin	65,000	267,000	24.3	2,785	Practically no levees
Middletown	115,000	304,000	37.8	3,162	No levees, wide flood channel
Hamilton	100,000	352,000	28.4	3,672	Levees above the city

TABLE 2. ESTIMATED COST OF COMPLETION OF ENTIRE PROJECT

Retarding Basins:	
Germantown	$640,247
Englewood	1,959,632
Lockington	865,218
Taylorsville	1,508,674
Huffman	1,299,125
	$6,272,884
Local Flood Protection:	
Piqua	$128,809
Troy	157,574
Dayton	1,384,619
West Carrollton	22,416
Miamisburg	167,267
Chautauqua	4,284
Franklin	115,076
Middletown	81,305
Hamilton	1,274,962
	$3,335,303
Total estimated cost of construction of the works included in the plan	$9,608,187
Public-service relocations and damages	2,300,315
Real-estate purchases and easements	5,664,200
Administration and general expense	1,758,170
Taxes and special assessments, during construction period, on lands acquired	200,000
Estimated cost without contingencies	$19,530,872
Contingencies	4,000,000
Estimated maximum total cost	$23,530,872

TABLE 3. MIAMI VALLEY RETARDING BASINS

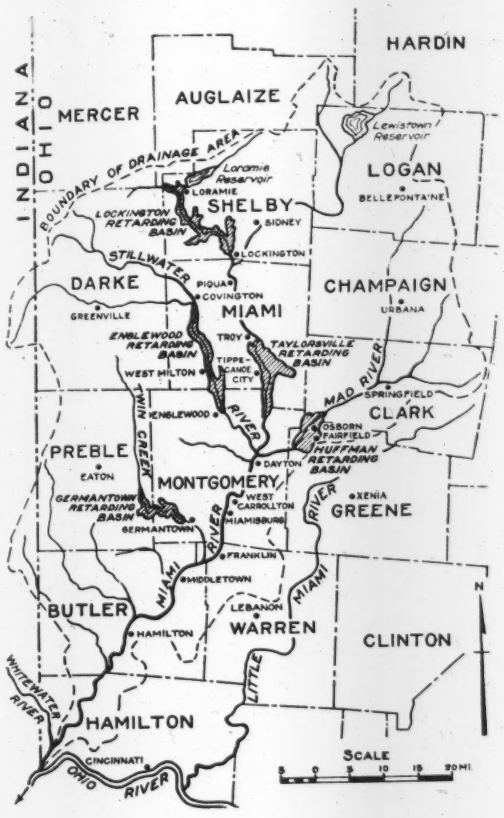
	Area, Acres	Capacity, Acre-Ft.	Drainage Area, Sq.Mi.	Height of Dam, Ft.†	Length of Dam, Ft.	Sectional Area of Outlets, Sq.Ft.	Discharge in Maximum Assumed Flood, Cu.Ft. per Sec.	Earth, Cu.Yd.	Concrete, Cu.Yd.
Lockington	4,020	70,000	355	62	6,400	158	9,400‡	1,135,000	38,000
Taylorsville	11,000	186,000	778*	59	2,980	1,116	55,000	1,235,000	47,000
Englewood	7,930	312,000	651	108	4,660	214	12,000	4,000,000	38,000
Huffman	9,180	167,000	671	58	3,340	705	35,000	1,655,000	40,000
Germantown	3,520	106,000	270	92	1,210	182	10,200‡	865,000	20,000

* Excluding area above Lockington dam. † From bed of river to crest of spillway. ‡ Approximate.

The computed flood discharges are very high. In the headwaters of the Miami they range generally from 80 to 150 cu.ft. per sec. per sq.mi. Near Dayton the figures for the three main rivers are 117 to 130. At Miamisburg, below Dayton, and at Miami, near the mouth of the river, the figures are 94 and 98 respectively, the drainage areas being 2,722 sq.mi. and 3,937 sq.mi. These several runoff figures correspond to entire concentration of a rainfall of 3½ to 5 in. per day (11 to 16 in. in 72 hr.). They represent the flow at maximum stages (not the 72-hr. mean). However, at Dayton the three-day total represented 6.94 in. of runoff.

The rainfall during the 1913 flood, for the worst three days, ranged from 6½ to 8 in. Eight other storms that occurred between 1889 and 1915 in different parts of the Northern states (one storm from Arkansas included) were of similar intensity, and at least three of them considerably exceeded the 1913 Ohio storm for the two- and three-day periods. The possibility of greater storms occurring must therefore be considered.

For this reason and also to have a safety margin against other factors of variation, the engineers of the Miami



RETARDING BASINS FOR MIAMI CONSERVANCY DISTRICT

Conservancy District based their designs on a storm runoff of 10 in. in 72 hr., which is about 40% greater than the three-day runoff at Dayton in March, 1913. At Taylorsville and Huffman it was believed that the runoff would concentrate more slowly and thus have the effect of a smaller total; 9½ in. in three days was assumed. For both cases the runoff was considered as increasing uniformly from ½ in. per 24 hr. to a maximum after 16 hr., this maximum continuing for 24 hr. and then falling off during the remaining 32 hr. of the 72-hr. period to a final amount of 1¼ in. and 2 in. per 24 hr. for the smaller and larger basins respectively.

With this assumed great flood the basins were designed of such capacity and height as to fill just to spillway level, while discharging freely through their normal outlet conduits. The earth embankments of the dams were then given 10 to 15 ft. freeboard above spillway level as a safety margin, and the spillways were designed long enough to take care of a flood 40% greater than that assumed, or twice as great as the 1913 flood, without overtopping the embankment.

The dams have permanent concrete outlet conduits through the base, ranging from two of 10-ft. diameter for the Lockington to four of 20½-ft. diameter for the Taylorsville dam. The outflow from these conduits limits the river flow below the dams. Under the condition of a storm like that of 1913 the flood discharge without basins and with the basins is: Lockington, 36,000 and 8,630 cu.ft. per sec.; Taylorsville, 127,000 and 51,300 cu.ft. per sec.; Englewood, 85,000 and 11,000 cu.ft. per sec.; Huffman, 78,000 and 32,600 cu.ft. per sec.; Germantown, 66,000 and 9,340 cu.ft. per sec.; at Piqua, 70,000 and 58,000 cu.ft. per sec.; at Dayton, 250,000 and 105,000 cu.ft. per sec.; at Hamilton, the lowest point taken into account in designing the protection works, 351,000 and 200,000 cu.ft. per sec.

River-Improvement Work

In connection with the figures just given, Table 1 is of vital importance.

This table at once makes it evident that the channel capacities are inadequate for even the regulated discharge and also are greatly variable. The cross-sections of the river vary in an irregular manner, and the levee or bank heights also are not consistent. For these reasons a large amount of channel-improvement work and levee construction is needed to supplement the protection afforded by the retarding basins.

Work of this character is contemplated at Piqua, where works now under construction by Miami County are declared to be quite insufficient; at Troy, where levee work, channel enlargement and improvement, a cutoff channel and construction of a sill across the river bed at a contracted bridge opening are planned; at Dayton, where a small amount of levee reconstruction and very extensive enlargement and rectification of the channel will be undertaken, at a total cost of about $1,383,000; at West Carrollton and Miamisburg, where a considerable amount of levee construction is to be done; at Chautauqua, Franklin and Middletown, chiefly levee construction; and at Hamilton, where the largest flow must be provided for and where channel enlargement and rectification will be an important element, besides complete levee protection along the east bank and along the northerly half of the west bank of the river.

The improvement system of the Miami Conservancy District interferes very little with existing railways. A number of important highways are cut by the retarding basins and must be relocated. A number of city bridges require raising or reconstruction to give sufficient flood clearance or width.

The total cost of the entire plan is estimated at $23,539,872, including an allowance of $4,000,000 for contingencies. Construction of the dams and river-improvement works consumes about one-half, or $9,608,187, not including contingencies. Of this sum about two-thirds will go into the five dams and one-third into river work. The two largest items of the latter are for Dayton and Hamilton, respectively $1,383,000 and $1,275,000. The cost figures are tabulated in Table 2.

The report now before the Board of Directors was made by Arthur E. Morgan, Chief Engineer to the District. The directors are Edward A. Deeds, Dayton; Henry M. Allen, Troy; and Gordon S. Rentschler, Hamilton.

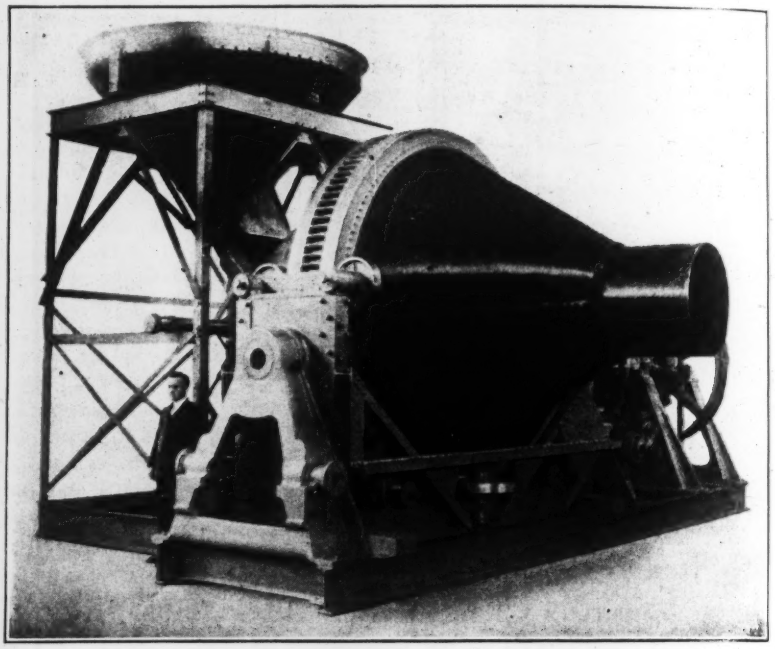
News of the Engineering World

Largest Concrete Mixers Built for Southern Dam

By far the largest concrete mixers ever manufactured have just been built by the T. L. Smith Co., Milwaukee, Wis., for the Hardaway Contracting Co., Columbus, Ga., for use on a concrete dam at Whitney, N. C., for the Aluminum Co. of America. The development is a revision of that proposed two years ago by the Southern Aluminium Co., and described in *Engineering News*, June 11, 1914, p. 1279. The earlier work was stopped by the European War, the holding company being a French concern.

Two mixers similar to the one shown in the accompanying view were built each with a capacity of 108 cu.ft. of mixed concrete per batch, or between 150 and 160 cu.ft. of unmixed material. Each machine is mounted on steel skids with a large batch hopper supported by a steel frame. The mixer itself is equipped with power tilt and clutch pulley. The weight of each machine is 46,000 lb. and the inside diameter of the drum ring is 9 ft. 6 in. Some idea of the size may be gained from a comparison with the man alongside the mixer.

The machines were built to special order, to take care of a contract that called for about 1,000,000 cu.yd. of concrete at a rate of 60,000 cu.yd. per month. At first, four 2-yd. mixers were decided upon as the proper equipment, but on account of local topography it was decided to have these two special 4-yd. mixers built to perform the same service.



ONE OF TWO 4-CU.YD. SMITH MIXERS BUILT FOR HARDAWAY CONTRACTING CO.

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State Supervision of Dams in Pennsylvania

The Pennsylvania Water-Supply Commission announced on Apr. 3 a policy for state supervision of dams, which has been framed in consultation with and has the approval of F. P. Stearns of Boston.

Following the disastrous failure of the dam at Austin, Penn., in September, 1911, the Pennsylvania legislature in 1913 enacted a law giving the State Water-Supply Commission authority to supervise the design, erection and maintenance of dams within the state. The commission outlines the reason why the construction of dams is increasing and shows that the dams of the future are likely to be much higher than those of the past, so that their failure would let loose greater quantities of water and cause more widespread destruction. As an example, the City of Johnstown, Penn., prior to 1908 received its municipal water-supply from seven small streams intercepted near their headwaters. The need of additional supply has caused the recent building of high dams to impound flood waters. A dam 100 ft. in height was constructed in 1913, and another of the same height is being erected. Another 100-ft. dam was built in 1913 to store water for the supply of the great steelworks of Johnstown.

These are but examples of what is going on all over the state. If such dams are not properly built, they may become, as was shown by the disastrous calamities at Johnstown and at Austin and more recently at San Diego, Calif., a serious menace to life and property. If the state permits the construction of such dams, it should see that they are built with due regard to safety. In order to fulfill this obligation the state must create an executive body with broad powers of inspection, supervision and control. It must also provide sufficient funds for an adequate and competent staff to enable the executive body to do its work.

The law of 1913 gives the requisite authority to the State Water-Supply Commission, but the appropriation for the work of the commission is inadequate to secure a staff sufficient to perform the duties in a proper manner. The commission's statement continues as follows:

> **The staff should be adequate and competent for: Investigating and reporting on plans submitted for new dams and for inspecting such dams during their construction; examining and reporting upon all existing dams which by their failure may cause loss of life or property and recommending changes required to insure the safety of such dams; inspecting changes in dams as they are made; examining from time to**

time such dams as require examination to insure that they are maintained in safe condition.

It is especially desirable that the engineering staff of the commission, as far as possible, be a permanent body, because it is not likely that vacancies can be filled with engineers fully qualified by study and experience to pass upon the difficult problems of dam design and construction.

A study of engineering textbooks does not by any means furnish all of the information required for the design of dams, and this is particularly true of the design of masonry dams, where the textbooks of the past have failed to take into account factors seriously affecting the safety of such dams.

While the commission may of necessity have to conduct to some extent a training school for the younger engineers whom it employs on this work, it should endeavor to make employment in the dam division sufficiently attractive to cause engineers to make it their life work. By adopting this policy and retaining competent trained engineers mistakes may be avoided. The commission cannot expect to retain competent engineers in this division if they are not paid salaries commensurate with the duties performed and the responsibilities imposed. The state should supply the funds necessary to permit this to be done.

Inadequate appropriations for this work are false economy, because the failure of a large dam impounding vast quantities of water, such as are retained by some modern dams, would undoubtedly destroy property representing more value than the amount of expense necessary to maintain an adequate staff of competent engineers for a quarter of a century. For example, the Johnstown flood in 1889 caused a loss of life of 2,142 and a loss of property estimated as between $3,000,000 and $4,000,000. At that time the population of Johnstown was about one-third of the present population, and the quantity of water stored in the reservoir which failed was only about one-third of that in an existing reservoir above the city, supplying water to the steel works.

The commission and its staff should require that every dam built in the future should be built to withstand not only the ordinary pressure of water against it, but every stress to which it may possibly be subjected by extreme floods and other causes. Where the failure of a dam may menace life or cause serious damage to property, it should be built in this safe way, and to insure this the commission should have adequate engineering advice.

Philadelphia Civil Engineers Favor House Change

A special meeting of the Philadelphia Association of Members of the American Society of Civil Engineers was held at the Engineers' Club of Philadelphia on Monday evening, Apr. 3, to consider the proposal now before the society to remove the New York headquarters to the Engineering Societies' Building. There was extended discussion, but all those taking part in it favored the proposal to join the other national engineering societies in the ownership and occupancy of that building; and the vote in favor of supporting the measure was unanimous.

The meeting further considered the statement, which has been widely circulated with the object of influencing members to vote against the proposition, that its acceptance will place the American Society of Civil Engineers under control of the United Engineering Society. After extended discussion the following resolutions were adopted without dissenting vote:

Whereas, An unofficial circular letter, dated Feb. 12, 1916, addressed to "the Members of the American Society of Civil Engineers," has been sent to the Philadelphia Association of Members of the American Society of Civil Engineers and to each of the 14 other local associations of the American Society of Civil Engineers by its author, J. A. Ockerson, Past-President of the society; and

Whereas, This letter contains the following statements:

An invitation has been extended to the American Society of Civil Engineers to enter "the United Engineering Society as an additional founder society." This invitation itself shows that the destinies of the "founder societies" are largely, if not wholly, controlled by a superior authority, and the fact must not be overlooked that the relationship which exists between the United Engineering Society and the founder societies which gives the former authority over them, has not been presented in detail to our members.

Suppose we become an "additional founder society" and desire to put before the public a measure which we have conceived and which we deem important. It must have the sanction of the United Engineering Society, representing a majority of the founder societies, which can prevent action, or if approved, the United Engineering Society would stand before the public as the sponsor of the measure. This illustration applies equally to all of the founder societies.

Whereas, It appears as the result of inquiries in authoritative quarters that these statements have no basis in fact and that they are therefore calculated to influence unfairly votes on the pending measure by which the American Society of Civil Engineers has been given an opportunity to become one of the founder engineering societies in relation to the United Engineering Society;

Be It Resolved, As the sense of this meeting, that this situation be brought promptly to the notice of the Board of Direction of the American Society of Civil Engineers through these resolutions and that it be recommended to the board, in the interest of fair play in a matter of momentous importance to the society, that the board issue an announcement to the membership-at-large, and at the earliest possible date, in official certification to the correctness or incorrectness of Mr. Ockerson's previously quoted statement.

Engineering Meeting on Water-Power Development

The American Institute of Electrical Engineers will hold a meeting in Washington, D. C., on Wednesday, Apr. 26, under the auspices of the Washington section and the Committee on Development of Water Power. Headquarters will be at the New Willard Hotel. Two sessions are to be held, the first beginning at 2:30 p.m. and the second at 8:15, both devoted to the specific question of water-power development as related to national industrial efficiency and preparedness. The official announcement of the institute states that:

The forthcoming meeting has been suggested by the Committee on Development of Water Power, which sees a further opportunity for service to the nation by directing the attention of the public and of Congress to the fundamental engineering and economic principles that underlie the water-power question and which must be taken into account if hydro-electric development is to be encouraged and stimulated. . . . At the present time Congress is considering the enactment of legislation intended to remove some of the legal obstructions which in the past have operated to deter capital from investment in hydro-electric enterprises, and the present, therefore, would seem to be a peculiarly opportune moment for the institute to be of service.

The papers to be presented are as follows: "Electrochemical Industries and Their Interest in the Development of Water Power," by Lawrence Addicks; "Water-Power Development and the Flood Problem," by Allerton S. Cushman; "The Relation of Water Power to Increased Transportation," by L. B. Stillwell; "The Relation of Water Power to the National Defense," by W. R. Whitney; "The Water-Power Situation, Including Its Financial Aspect," by Gano Dunn.

Co-operation Conference

The idea of coöperative action by engineering societies, which last summer led Prof. F. H. Newell and others to form a Volunteer Committee on Engineering Coöperation, will be further promoted at a general conference, Apr. 13 and 14. Engineering societies throughout the country have been invited to send delegates; so far 25 of them have accepted in definite form. The conference will be held at Chicago, Ill., in the rooms of the Western Society of Engineers.

An active program has been outlined. Individual short addresses on the following subjects will be delivered: Coöperation Among Engineering Organizations, Practicability of Coöperation, Results of Coöperation in

Minnesota, The Philadelphia Plan, The Chicago Engineers' Club, Cooperative Efforts in Chicago, Ideals and Accomplishments of Various Types of Engineering Organizations, National Societies, Publicity at Cleveland, Cleveland Local Sections, Employment, Education, Engineering Profession and Public, Legislative Activity by Engineering Organizations. The speakers will probably include the following, among others: Prof. John F. Hayford, P. Junkersfeld, C. E. Drayer, A. J. Himes, Arthur Kneisel, John Howe Peyton, H. H. Esselstyn, H. S. Nichols, George H. Herrold, Edward Haupt.

A Drainage Survey of Georgia, to be made by S. W. McCallie, state geologist, has been ordered by the State Geological Board.

A State Highway Commission for Mississippi has been established by the legislature. It will be composed of three unpaid members and of a highway engineer at $2,500 a year, all appointed by the governor.

Stopping the Cedar Lake Reservoir Leaks by placing soft sediment from the bottom of the lake on the moraine through which the water passes has been proposed by William Mulholland, consulting engineer, Los Angeles, Calif., in a preliminary report to the city authorities of Seattle, Wash.

Rapid-Transit Schemes in Pittsburgh, Penn., are still alive. The Pittsburgh Subway Co., on Mar. 21, appeared before a councilmanic committee to renew an application for a franchise for a subway to extend from Liberty Ave. near the Point out to Central Ave. and Grand Boulevard, where the tracks would rise to the surface. Such a line would cost about $20,000,000. The committee took no action.

Water-Softening at a Second Filtration Plant for Minneapolis, Minn., as recommended by F. W. Cappelen, city engineer, has been approved by the water-works committee of the City Council, and it is thought that the council will order the immediate preparation on plans and estimates. The proposed plant would have a capacity of 45,000,000 gal. a day, like the present one, and is estimated to cost $700,000.

A Volunteer Engineer Corps for California is proposed by a committee consisting of Col. W. R. Livermore, U. S. A.; Capt. Richard Park, Corps of Engineers, U. S. A.; C. W. Thomas, Jr., Adjutant General, California National Guard; Joseph P. Smedberg, secretary. Companies are to be formed in San Francisco, Sacramento, Oakland, Los Angeles and other cities of the state as interest develops. It is hoped to have a corps of 1,000 engineers organized within six days.

Philadelphia Rapid Transit Plans have again been revised, this time by an act of the Finance Committee of the City Councils. As noted in "Engineering News," Mar. 23, 1916, p. 581, the new Director of Transit, W. S. Twining, curtailed the previous rapid transit plans by reducing the length of many of the lines. On Apr. 3 the Councils Committee voted to authorize a loan of $57,100,000 for extensions that practically follow the routes laid out by the previous head of the department, A. M. Taylor.

Three-Train Wreck Kills 26—A disastrous wreck occurred on the New York Central lines at Amherst, Ohio, on Mar. 29, when the second section of train 86, known as the Pittsburgh-Baltimore-Buffalo limited, traveling at 50 mi. per hr., crashed into the first section, which was traveling at not more than 10 mi. per hr., having recently been stopped. The rear car of first No. 86, which contained all the passengers who were killed or seriously injured (26 killed, more than 40 injured), was thrown over on the westbound track—as was also the steel-underframe car ahead—just as the Twentieth Century limited was approaching from the opposite direction. The latter train of eight cars collided with a portion of the wreckage and was derailed, with the exception of the last three cars. Following an investigation by the railway, the engineer of second No. 86 was dismissed by the company. He passed the flagman sent back to warn him and is held responsible for the wreck.

A Reconstruction Exposition is to be held in Paris, France, opening on May 15. It will be devoted especially to buildings and building materials in connection with the plans to restore and rebuild those sections of France devastated by the war. Exhibits from the United States will be shown in a special American section. The American exhibits are in charge of Henry C. Long, 41 Boulevard Haussmann, Paris. In a letter to "Engineering News," Mr. Long says: "Behind the fighting lines in Belgium and France there is widespread wreck and ruin. The whole must be rebuilt and rebuilt quickly, so that France will not be left in the rear commercially at the close of the war. The French want any contractor who can finance a building contract or a contract of any other kind to be ready to assist in the work of rebuilding. They want the quickest possible methods in building construction and every form of construction from the cheapest to the most costly. Some of it will be temporary, most of it will be permanent. There will never be such an opportunity for American engineers, contractors and architects in the world as there will be in Europe after the war. There is a belief in France that American engineers are more up to date and can work more rapidly and cheaply than Europeans, and there is a chance to show it in this exposition."

Severe Fires in the Central South on Mar. 22 were especially damaging to Augusta, Ga. ($5,000,000), and Nashville, Tenn. ($1,000,000). Other Southern cities to suffer to a lesser extent were Chattanooga and Lewisport, in Tennessee, Spray, N. C., and Atlanta. At Augusta six business blocks and more than 600 residences were destroyed by a fire that started near an elevator shaft in a five-story brick and wood store building. The Citizens' and Southern bank, a granite building, was only slightly damaged; but the Augusta Chronicle Building, 10 stories high and of concrete and steel, was gutted. It is believed, however, that the frame and walls were but little damaged. The Empire Life Building, steel frame, 16 stories, now under construction caught fire, and the interior was burned. It is thought that the frame and the brick walls are still sound. The aggregate loss to business houses was $2,000,00 and to cotton warehouses and compresses, $1,000,000. In Nashville the fire was confined to a residence section on the east side of the Cumberland River, and the large buildings destroyed were schools and churches. Following the fire in Nashville an ordinance was passed prescribing a zone in this section in which no wooden buildings may be erected. The regulation was to have been a part of the new general building code, but was put through at once to forestall hazardous rebuilding.

PERSONALS

Mr. Guy Pinner, Assoc. M. Am. Soc. C. E., has been appointed Bridge Engineer of the Seaboard Air Line Ry., with headquarters at Norfolk, Va.

Mr. F. J. Hagner, Train Master of the Philadelphia & Reading Ry., at Allentown, Penn., has been appointed Superintendent of the Shamokin division.

Mr. J. E. Kissell has been appointed Acting Engineer of Maintenance-of-Way of the Peoria & Eastern Ry., to succeed A. M. Turner, mentioned elsewhere.

Mr. E. H. McGovern has been appointed Resident Engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Columbus, Ohio.

Mr. R. H. Randall, Assistant Engineer in charge of Topographic Survey, Dayton, Ohio, has gone to Jackson, Mich., to take charge of a topographic survey which that city will carry out.

Mr. R. Boone Abbott, who recently was appointed Superintendent of the Shamokin division of the Philadelphia & Reading Ry., has been made Superintendent of the Harrisburg division to succeed Mr. Stackhouse.

Mr. L. B. Lyman, Superintendent of the Chicago, Burlington & Quincy R.R., at Wymore, Neb., has been appointed Superintendent of the Aurora division, with headquarters at Aurora, Ill. He succeeds Mr. A. G. Smart.

Mr. Ralph L. Rizer, who has been for the past 10 years in the Engineering Department of Cumberland, Md., has been made City Engineer by the newly elected commissioners of that city. He succeeds James P. Gaffney, retired.

Mr. R. J. Stackhouse, Superintendent of the Harrisburg division of the Philadelphia & Reading Ry., has been made Superintendent of Materials and Supplies, with headquarters at Reading. He succeeds the late James K. Witman.

Mr. A. G. Smart, Division Superintendent of the Chicago, Burlington & Quincy R.R., at Aurora, Ill., has been appointed Superintendent of the Beardstown division, with headquarters at Beardstown, Ill. He succeeds Mr. F. Cone, transferred.

Mr. A. M. Turner, Assoc. M. Am. Soc. C. E., until recently Acting Engineer of Maintenance-of-Way of the Peoria & Eastern Ry., has been appointed District Engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Columbus, Ohio.

Mr. Harrison Pendel, South Chicago, Ill., has been made Superintendent of the Meiley blast furnaces, at Lebanon,

Penn. The furnaces are now being remodeled and new machinery is being installed. Mr. Pendel is acting as engineer in charge of construction at present, but will operate the furnaces when they are completed.

Mr. B. M. Cheney, recently Acting General Inspector of Permanent Way and Structures of the Chicago, Burlington & Quincy R. R., has been appointed General Inspector, with headquarters at Chicago. Mr. Cheney entered the service of the Chicago, Burlington & Quincy in 1906 as assistant engineer on construction and maintenance on the Beardstown division and four years later was transferred to the La Crosse division, in charge of second-track construction. In 1904 he was appointed Assistant to the General Inspector of Permanent Way and Structures, being made Acting General Inspector in January, 1915.

Mr. Arthur Falkenau, M. Am. Soc. M. E., Vice-President of the Hooper-Falkenau Engineering Co., Industrial Engineers and Architects, New York City, has been engaged as Acting Consulting Engineer of the Canadian Car and Foundry Agency, which is carrying on the production of munitions for Russia in some 80 plants in the United States and Canada. Mr. Falkenau has had extended experience in munitions manufacture, having made shrapnel for the United States Government during the Spanish-American War. He has also built special machines of his own and of the Government designs for several United States arsenals.

Mr. Agnew T. Dice, Jr., formerly Assistant Train Master of the Philadelphia & Reading Ry., at Reading, Penn., has been appointed General Inspector, with headquarters at Reading. Mr. Dice was born in 1890. In 1912 he graduated from Princeton University with the degree of civil engineer, immediately afterward entering the service of the Philadelphia & Reading as rodman in the Chief Engineer's office. In 1913 he was made Assistant Supervisor in the Division Engineer's office at Reading and a year later became Assistant Supervisor of the Atlantic City R.R. On Apr. 1, 1915, Mr. Dice was appointed Assistant Train Master of the Philadelphia & Reading, which position he has held up to his present appointment. He is the son of Agnew T. Dice, who recently became President of the Philadelphia & Reading Ry.

Mr. Albert John County, Assoc. Am. Soc. C. E., who for the past 10 years has been assistant to Mr. Samuel Rea in the respective capacities of Assistant to Vice-President and Special Assistant to President of the Pennsylvania R.R., Philadelphia, Baltimore & Washington R.R., West Jersey & Seashore R.R. and Northern Central Ry., becoming Vice-President of the latter company in 1914, has been appointed Vice-President in Charge of Accounting of the Pennsylvania R.R., of the Philadelphia, Baltimore & Washington R.R. and West Jersey & Seashore R.R. He is also charged with the promotion or acquisition of new lines, the corporate work connected with all branch or affiliated companies east of Pittsburgh and Erie and the maintenance of their corporate organizations. He is also Assistant to the President and a Director of the New York Connecting R.R.

OBITUARY

C. D. Stamper, formerly of Dayton, Ky., and S. R. Stevenson, of Christiansburg, Va., civil engineers in the employ of the Carolina, Clinchfield & Ohio Ry., were killed by a train at Dante, Va., on Mar. 28.

Max M. Suppes, M. Am. Soc. M. E., General Manager of the National Tube Co., died at Elyria, Ohio, on Mar. 27. He had been a resident of Elyria for 22 years, where he went to superintend the construction of the Johnson Steel Co., now the National Tube Co.

William Butler, a prominent contractor and financier of St. Paul, died at Rochester, Minn., on Mar. 15. Mr. Butler had been a resident of St. Paul for 30 years. He was President of the Butler Brothers Building Co. and President of the Farm Mortgage Bond Co.

William Milholland, civil engineer, of Norfolk, Va., died on Mar. 26 in the Norfolk hospital from a gunshot wound. His gun was accidentally discharged while he was hunting rabbits. He was born in Pittsburgh and was the son of the late John M. Milholland, founder of Milholland & Co., of that city. Mr. Milholland was 35 years of age.

James W. Gillespie, Assistant Engineer of the Pennsylvania Public Service Commission, died at his home in Harrisburg, Penn., on Mar. 29. He was 70 years old. Mr. Gillespie recently acted as the expert adviser to the Public Service Commission in a series of telephone-rate hearings that attracted widespread attention. He was a member of the Telephone Pioneers of America and of the Engineers' Society of Pennsylvania.

Louis P. Morehouse, of Chicago, who died at Los Angeles, Calif., on Mar. 18 at the age of 81 years, was for many years connected with the Illinois Central R.R. He was born at New Haven, Conn., in 1835. After graduating from the Sheffield Scientific School of Yale University, he became a rodman for the New London & Stonington R.R. in 1856. The next year (1857) he went to the Illinois Central as Assistant Engineer and was finally Assistant Chief Engineer. In 1877 he entered the business department of the railway and later held the positions of Land Commissioner, Tax Commissioner and Custodian of Deeds until 1905, when he retired with a pension. He was one of the founders of the Western Society of Engineers and was its secretary for 19 years. He was elected an honorary member of the society in 1887.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Apr. 11-14. Spring meeting in New Orleans. Secy., Calvin Rice, 29 W. 39th St., New York City.

CONFERENCE ON ENGINEERING CO-OPERATION.
Apr. 13-14. Conference in Chicago. Secy., C. E. Drayer, Cleveland, Ohio.

AMERICAN CHEMICAL SOCIETY.
Apr. 18-21. Annual meeting at the University of Illinois, Urbana-Champaign. Secy., Charles L. Parsons, Washington, D. C.

NATIONAL ASSOCIATION OF COTTON MANUFACTURERS.
Apr. 26-27. One-hundredth annual meeting in Boston. Office of secretary, 45 Milk St., Boston, Mass.

AMERICAN ELECTROCHEMICAL SOCIETY.
Apr. 27-29. Annual meeting in Washington. Secy., J. W. Richards, Lehigh University, South Bethlehem, Penn.

AIR BRAKE ASSOCIATION.
May 2-5. Convention in Atlanta. Secy., E. M. Nellis, 53 State St., Boston.

CANADIAN RAILWAY CLUB.
May. Annual meeting in Montreal. Secy., James Powell, P. O. Box 7, St. Lambert, near Montreal.

RAILWAY DEVELOPMENT ASSOCIATION.
May 9-11. Annual meeting in New Orleans. Secy., H. O. Hartzell, B. & O. R.R., Baltimore, Md.

NATIONAL FIRE PROTECTION ASSOCIATION.
May 9-11. Annual meeting in Chicago. Secy., Franklin H. Wentworth, 87 Milk St., Boston.

AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION.
May 10-12. Convention in Pittsburgh. Secy., F. D. Mitchell, 1510 Woolworth Building, New York City.

NATIONAL DISTRICT HEATING ASSOCIATION.
May 16-19. Eighth convention in New York City. Secy., D. L. Gasgill, Greenville, Ohio.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.
May 17-20. Annual convention in Galveston, Tex. Secy., H. S. Cooper, Slaughter Building, Dallas, Tex.

NATIONAL ELECTRIC LIGHT ASSOCIATION.
May 22-26. Convention in Chicago. Secy., T. C. Martin, 29 W. 39th St., New York City.

MASTER BOILER MAKERS' ASSOCIATION.
May 23-26. Annual meeting in Cleveland. Secy., H. D. Vought, 95 Liberty St., New York City.

AMERICAN IRON AND STEEL INSTITUTE.
May 26-27. General meeting in New York City. Secy., J. T. McCleary, 61 Broadway, New York City.

NATIONAL CONFERENCE ON CITY PLANNING.
June 5-7. Conference in Cleveland. Secy., Flavel Shurtleff, 19 Congress St., Boston, Mass.

AMERICAN WATER-WORKS ASSOCIATION.
June 5-9. Convention in New York City. Secy., J. M. Diven, 47 State St., Troy, N. Y.

SOCIETY OF RAILWAY CLUB SECRETARIES.
June 16-17. Annual meeting in Atlantic City. Secy., H. D. Vought, 95 Liberty St., New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 27-30. Annual meeting in Pittsburgh. Secy., Charles Warren Hunt, 220 West 57th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 27-July 1. Annual meeting in Atlantic City. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

Detroit Association of the American Society of Civil Engineers will probably be formed following a meeting of American Society members to be held at the Detroit Engineering Society on Apr. 4. This meeting was held to consider the advisability of such a proceeding.

American Institute of Electrical Engineers will hold its midsummer convention in Cleveland, Ohio, June 29 to 30. The annual meeting of the institute will be held in New York City on May 16, at which time the officers for the ensuing year will be elected. The secretary is F. L. Hutchinson, 33 West 39th St., New York City.

National Conference on City Planning—The date of the conference is given in the list of coming meetings as June 5-7.

The secretary, Flavel Shurtleff, has written, however, that before this date is official, approval must be secured from the Cleveland local committee. The secretary's address is 19 Congress St., Boston.

Engineers Society of Pennsylvania celebrated its twelfth anniversary and held its second annual banquet at the Harrisburg Club on Mar. 25, as announced in the Mar. 24 issue of "Engineering News." More than 200 members and guests were present. The society has made an excellent record in its 12 years of existence. It has a membership of 700 and is housed in its own building.

American Supply and Machinery Manufacturers' Association holds it annual convention in Pittsburgh, May 10 to 12, in conjunction with the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association. The National Pipe and Supply Dealers' Association meets May 8 to 9. The headquarters in each case is the William Penn Hotel.

Michigan Detroit-Chicago Paved-Way Association held a meeting at the Post Tavern, Battle Creek, Mich., on Mar. 24. The object of the meeting was to discuss the outlook for the proposed paved way and to consider the forthcoming State Good Roads Convention to be held in Battle Creek in May. It is believed that the Michigan Good Roads Congress will be held in the week of May 8.

A Highway Meeting in Harrisburg, Penn., was called by Governor Brumbaugh on Mar. 27, and 650 persons attended from 14 counties. Plans for building a highway, to be known as the William Penn Highway, from Philadelphia to Pittsburgh through Reading, Harrisburg, Johnstown and the picturesque Juniata were formulated. It is proposed that this highway shall connect with the Pike's Peak Ocean to Ocean Highway. A permanent organization was formed to look after the necessary legislation, and officers were elected as follows: President, William Jennings; vice-presidents, F. Murray Africa and Frank M. Graeff; treasurer, David Barry. The Board of Governors includes a representative from each county.

Appliances and Materials

New Elevating Dumping Body for a Motor Truck

The elevating dumping body illustrated is supplied on trucks furnished by the Gramm-Bernstein Co., Lima, Ohio. These trucks are built especially for contractors and builders and are suitable for hauling coal, cement, asphalt, stone, sand, gravel and other materials used in building work and roadmaking. The left view shows the body in position to discharge the load.

The body is operated by a hydraulic hoist mounted in the center, driven by a propeller shaft from an auxiliary driving mechanism of the truck. It is easily operated by levers, and there are no troublesome chains and sprockets. The body rises smoothly and evenly under load. A stabilizing device, visible at the corners of the body in the left view, prevents overbalancing or tilting when the compartment at one end is empty and the other end is full.

The company builds all kinds of bodies on order. The sizes and prices of Gramm-Bernstein trucks are listed as follows: 1 ton, $1,500; 1½ tons, $1,800; 2 tons, $2,400; 2½ tons, $2,600; 3½ tons, $3,400; 5 to 6 tons, $4,300.

* * *

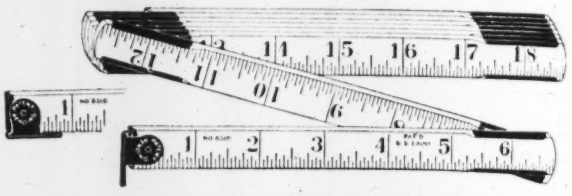
Vestibule Telephones

A telephone outfit for apartment-house vestibules, replacing the old speaking tubes, has been designed by the Connecticut Telephone and Electric Co., Meriden. It is applied to the customary mail-box plates. The transmitter is at the top and has a special metal mouthpiece permanently attached to the front plate. A watch-case receiver hangs down from one side by an armored cable. The apartment occupants' names are grouped in a vertical row of card holders, with a push button opposite each.

* * *

Hook for Jointed Rule

A new device for spring-joint foot rules is a folding right-angle hook that can be dropped over a projection. It is especially intended for use in taking measurements from points that are out of arms' reach, but is convenient in many other cases. The hook is on the end of the rule and normally lies



FOLDING RULE WITH HOOK END

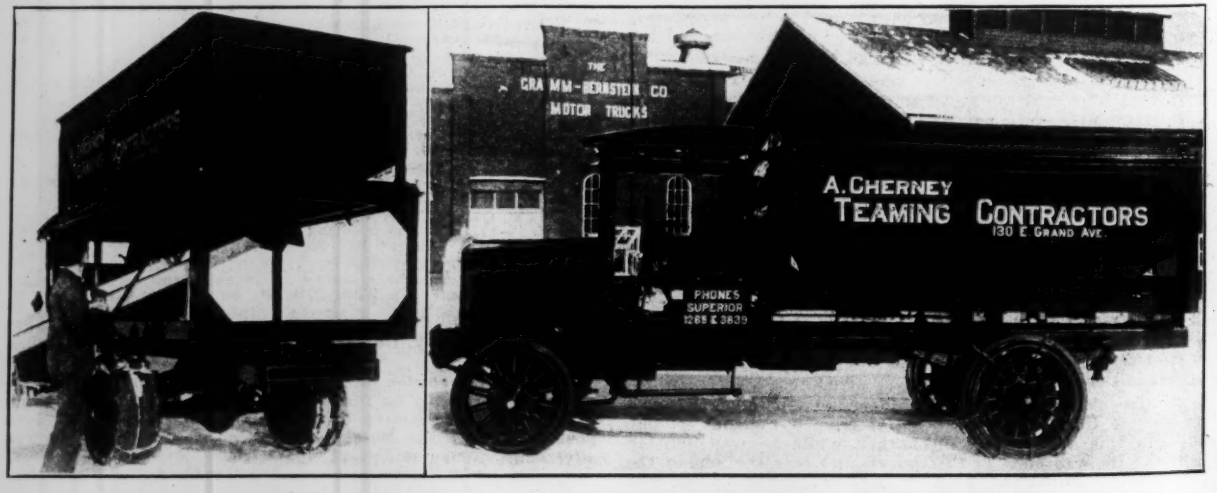
closed against the edge. The zero point is at the inside face of the hook when this is open, as shown. When the hook is folded back out of use, the zero point is at the end of the rule. This device is being introduced by the Lufkin Rule Co., Saginaw, Mich.

* * *

A Storage Tube for Drawing Paper

A metal tube for conveniently protecting and storing blueprint paper, tracing paper and cloth has just been placed on the market by Kolesch & Co., 138 Fulton St., New York City. The "Security" tube is made in three lengths, 30, 36 and 42 in., of heavy tin japanned black. The greatest advantage is the elimination of the necessity for opening the tube every time paper is required.

The paper is easily loaded into the tube by pushing back the slide-cover and closing it, the paper remaining thoroughly protected without again opening the tube until the entire roll has been used. A tape measure is mounted on the cover for convenience in obtaining the length of paper desired, which is easily cut by means of the straight cutting edge on the flap of the cover. Brackets also are furnished, so that the tube can be fastened either to a drafting table or to the wall. The list prices for Models A, B and C, of 30-, 36- and 42-in. tubes, are $4.50, $5 and $5.75 respectively.



TWO VIEWS OF THE GRAMM-BERNSTEIN ELEVATING DUMPING BODY